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July 18, 2008
SEST-1104-0031-0016
5.0 / Deliverables

Ms. Suzanna Jefferis
Remedial Project Manager
Naval Facilities Engineering Command, Northwest
1101 Tautog Circle, Suite 203
Silverdale, WA 98315-1101

SUBJECT: FINAL APPENDIX F, SITE WORK PLAN, TIME CRITICAL REMOVAL ACTION, BREMERTON NAVAL COMPLEX (BNC), OU A CHARLESTON BEACH, BREMERTON, WASHINGTON

Ref: Contract N68711-04-D-1104 for Environmental Remediation Services in Alaska, Arizona, California, Nevada, New Mexico, Oregon, Utah, and Washington

Dear Ms. Jefferis:

Enclosed are 2 hard copies and one (1) CD-ROM of the Final Appendix F to the Site Work Plan for the Interim Repair Action at OU A Charleston Beach, Bremerton Naval Complex, Bremerton, Washington. Additional hard copies have been submitted to the Stakeholders as requested (see below). This document includes:

- Specifications and Design Drawings for the Interim Repair Action
- Attachment A – Fish Mix Design Document
- Attachment B – Interim Repair Action Design Memorandum

Please call either Shanti Montgomery at (360) 780-1433 or myself at (206) 842-4247 regarding comments or questions on this submittal.

Sincerely,

Thomas C. Goodlin, LHG
Senior Hydrogeologist
SES-TECH

Enclosure
cc: Rod Gross (w/out attachment)
Kimberly Gillette (w/out attachment)
Denice Taylor – Suquamish Tribe Fisheries Department (1 hard copy)
Tom Ostrom – Suquamish Tribe Fisheries Department (1 hard copy)
Nancy Harney – U.S. Environmental Protection Agency (1 hard copy)
Chung Yee – Washington State Department of Ecology (1 hard copy)

13810 SE Eastgate Way, Ste 420 Bellevue, WA 98005
Tel 425 283-0630 Fax 283-0650

Enclosure (continued)

cc: Chris Waldbillig – Washington Department of Fish and Wildlife (1 hard copy)
Susan Moore – CH2M Hill (1 hard copy)
Gerald Sherrell – PSNS & IMF, BNC (1 hard copy)
Christine Gebhardt – Environmental, BNC (1 hard copy)
Tyler Yasenak – Environmental, BNC (1 hard copy)

13810 SE Eastgate Way, Ste 420 Bellevue, WA 98005
Tel 425 283-0630 Fax 283-0650

TETRA TECH

SPECIFICATIONS COVER SHEET

ENGINEER: Tetra Tech EC, Inc.

CONTRACT: Environmental Remedial Action Contract

Contract No. N68711-04-D-1104

PROJECT: Task No. 0031, 07 Time Critical Removal Action

Bremerton Naval Complex (BNC) , OU A Charleston Beach

LOCATION: Bremerton Naval Complex, Bremerton, Washington

Prepared By:

Senda Ozkan, PE — July 16, 2008

Senda Ozkan, PE — Date

Reviewed By:

Mitch Baron — July 16, 2008

Mitch Baron — Date

Approved By:

Shanti Montgomery — July 16, 2008

Shanti Montgomery — Date

TETRA TECH

REVISION LOG

Revision Date	Revision No.	Prepared By	Description of Changes	Affected Pages
16 July 2008	0	Senda Ozkan, PE	Original Issue	All

TETRA TECH

TABLE OF CONTENTS

SPECIFICATION SECTIONS

SECTION 01 57 13
TEMPORARY EROSION AND SEDIMENT CONTROL

PART 1 - GENERAL

1.01 SUMMARY

This section provides the technical requirements for designing, furnishing, installing, and maintaining dust control, and erosion and sediment control systems to limit the discharge of turbid water from the construction site.

1.02 REFERENCES

Materials and services furnished shall meet the substantive requirements (as allowed under CERCLA) of Federal, State, local laws, ordinances and regulations, some of which are listed herein.

- HPA from WDFW (RCW 75.20.100; WAC 220-110)
- CZMA and SMA; 16 USC 1456, 15 CFR 930, RCW 90.SE, and WAC 173-016.
- The Water Pollution Control Act (Chapter 90.48 RCW) and the Water Resources Act of 1971 (Chapter 90.54 RCW)
- The Wetland Protection Act (Executive Order 11990, 40 CFR, Part 6)
- Federal Clean Water Act requirements for standards for stormwater permits (40 CFR 122)
- State of Washington requirements for fugitive emissions (WAC 173-400-040)
- Puget Sound Clean Air Agency (PSCAA) Regulation 1, Section 9.15.
- Standards and Specifications for Best Management Practices for Erosion and Sediment Control, Stormwater Management Manual for the Puget Sound Basin, February 1992.
- EPA-430/9-73-007-Processes, Procedures and Methods to Control Pollution Resulting from all Construction Activity
- Ecology Draft Regulations for Management of Stormwater (issued spring 1992)

1.03 SUBMITTALS

Not Used

1.04 APPLICABLE STANDARDS AND SPECIFICATIONS

Washington State Department of Transportation (WSDOT), Standard Specifications: 1994 Standard Specifications for Road, Bridge and Municipal Construction, M41-10

USACE Nationwide General Permit

HPA of WDFW

PSCAA fugitive dust control regulations

PART 2 - PRODUCTS

2.01 SILT FENCES

Silt fences shall possess the properties required to prevent downstream sediment transport.

2.02 SANDBAGS

Sandbags shall be made of a woven polyester fabric with a string tie. Any bags that have rot or otherwise are deteriorated shall be replaced as directed by the Site Superintendent.

2.03 DUST CONTROL

If dust suppression becomes necessary, water that is used shall be clean fresh water from a local fire hydrant (or equivalent), free from salt, oil, and other deleterious material. Equipment for dust control shall be capable of accessing all work areas.

PART 3 - EXECUTION

3.01 GENERAL

Temporary erosion and sediment control measures shall be provided and maintained to minimize off-site movement of sediment. The Site Superintendent and subcontractor(s) shall comply with all applicable laws concerning soil erosion, turbidity, and sediment control.

The Site Superintendent shall review the approach for erosion control with the Task Order Manager (TOM) and subcontractors prior to implementing this section on erosion and sediment control to accommodate soil disturbance and rock placement on site. A copy of this specification, the Site Work Plan (SWP), and the Standards and Specifications for Best Management Practices for Erosion and Sediment Control shall be kept at the site.

3.02 UPLAND MODIFICATIONS

A. The Site Superintendent shall be responsible for the installation and maintenance of all erosion control measures during the course of construction and shall make every effort to minimize erosion that may result from excavation and backfill operations.

Erosion and sediment control measures shall be maintained as necessary during all phases of the construction work.

B. The Site Superintendent shall implement strict dust control measures during active construction periods on site. These control measures will generally consist of water applications that shall be applied as dictated by visual emissions and weather conditions.

C. Unless otherwise directed by the Site Superintendent, sediment control measures shall not be removed. The sediment control measures will be removed following completion of the site restoration activities.

D. All temporary stockpiles shall be located within areas protected by sediment control measures.

E. Erosion control location adjustments shall be made in the field as necessary. The minimum area practical shall be disturbed for the minimum possible time.

F. Catch basins that receive runoff from disturbed areas shall be inspected on a regular basis and cleaned, as necessary. All measures necessary to control, filter, or prevent sediment build up shall be implemented.

G. All points of construction ingress and egress shall be protected to prevent tracking of mud onto paved roads. Mud/soil shall be removed from paved roadways, as necessary.

3.03 INTERTIDAL ZONE CONSTRUCTION

A. Man-made debris and deleterious materials shall be removed from the beach and placed in an upland location as directed by the Site Superintendent.

B. Materials shall not be stored or otherwise stockpiled on the beach.

C. Activities shall be conducted to minimize siltation of the beach area.

D. No petroleum products or other deleterious materials shall enter surface waters. Spill control equipment, including boom and absorbent materials, shall be available to control any accidental spills.

E. No burning will be allowed on the beach.

F. If a fish kill occurs or fish are observed to be stressed, the activity shall cease and the Site Superintendent shall be notified immediately.

G. Rock placement shall be conducted in a manner that will avoid erosion and siltation to the maximum degree possible.

H. Bank sloping shall be accomplished in a manner that avoids the release of material into the water.

3.04 ENVIRONMENTAL PROTECTION

A. Construction-generated trash and debris shall be properly disposed of in accordance with the Bremerton Naval Complex approved Waste Information Sheet [WIS (see SWP Section 5)].

B. No material shall be burned on site.

C. The Site Superintendent shall minimize and control dust at the site to such a degree as to avoid a hazard or nuisance to others.

END OF SECTION

PART 1 - GENERAL

1.01 SUMMARY

This work includes the construction of an upland planter section. Details of the creation of the planter section will be as directed by the Site Superintendent. The planter section shall accommodate various types of vegetation including groundcover, shrubs, and trees, which will be procured and installed by others at a later date.

1.02 RELATED SECTIONS

Not Used.

1.03 REGULATORY REQUIREMENTS

Not Used.

1.04 APPLICABLE STANDARDS AND SPECIFICATIONS

Not Used.

1.05 SITE PREPARATION

The Site Superintendent shall direct site preparation for the planter section, including excavation and grading.

1.06 DELIVERY, STORAGE, AND HANDLING

Materials delivered to the site shall be inspected for damage, unloaded, and stored in a manner to mitigate any damage to the materials. .

1.07 SUBMITTALS

Following construction, a markup of the drawings and this specification showing the as-built condition of the planter section shall be submitted.

PART 2—PRODUCTS

A. Soil Medium

Soil for the planting area shall be a 75 / 25 topsoil / organic matter mixture with the following specifications for the topsoil component:

pH:	5.5 to 7.0
Soluble salts:	600 ppm max.
Silt:	25 to 30%
Clay:	5 to 10%
Sand:	60 to 70%

The volume of soil placed shall be such that a minimum soil depth of 3 feet is present along the curb and above the armor rock as indicated on the OUA Charleston Beach Fish Mix Design Plan (Drawing Number 0031-GP-ALT4). The thickness of topsoil

will be adjusted to match top of curb and taper to match top of riprap. Only those areas with less than 3 feet of topsoil will require the placement of additional topsoil.

B. Large Woody Debris

Woody debris impacted by placement of the armor rock will be repositioned along the beach in front of the sheet pile wall at an approximate elevation of +14 MLLW. The woody debris shall be placed in a staggered arrangement.

C. Vegetation

No vegetation will be installed as part of the interim action. Any vegetation installed after the implementation of the interim action shall be limited to species used in the earlier plantings.

PART 3—EXECUTION

3.01 Planter Section

The planter section shall be constructed as shown on Drawing Number 0031-GP-ALT4. After confirmation that a 3 foot thick layer of topsoil is present, geotextile secured with a 6-inch thick layer of filter rock will be placed over the topsoil as indicated on Drawing Number 0031-XS-ALT4.

END OF SECTION

SECTION 31 35 00
SLOPE PROTECTION

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

The work includes furnishing all material, labor and equipment necessary for providing the armor rock and geotextile fabric at the locations shown on the design drawings and described in this specification.

1.2 APPLICABLE PUBLICATIONS

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

A. American Society for Testing and Materials (ASTM)
   ASTM C 127 Specific Gravity and Absorption of Coarse Aggregate

B. American Association of State Highway and Transportation Officials (AASHTO)
   M288-96 Geotextile Specifications for Paving Fabrics

C. Washington State Department of Transportation (WSDOT)
   WSDOT 113 Degradation Factor

1.3 SUBMITTALS

Submit test reports $\leq$ 9 months old for materials as required in Sections 2.3 and 2.4.

PART 2 - PRODUCTS

2.1 MATERIAL SOURCES

Material sources shall be selected by the Contractor and included in the submittal of Proposal and Bid Documents. Suitable representative samples and test reports must be submitted with the proposal and approved by SES-TECH prior to delivery of materials to the jobsite.

2.2 GENERAL REQUIREMENTS

All rock shall be dense sound, clean, rough angular, durable stone. The longest dimension of any stone shall not exceed three times its shortest dimension. Acceptability of stones will be determined by laboratory tests, as hereinafter specified, geologic examination, and service records.

2.3 EVALUATION TESTING

The Contractor shall submit to SES-TECH all pertinent test results and service records from the proposed source. All testing shall be conducted by a laboratory that is independent of the material supplier. These test results shall be recent (less than 9 months old). The tests shall be performed in accordance with, and meet the requirements of Paragraph 2.4 (Rock Quality) below. Satisfactory Contractor documentation of laboratory test results on rock samples will not constitute approval of all rock in the quarry and will not in any way change the Contractor's responsibility for obtaining and

developing a satisfactory source of rock. In addition, the Contractor shall also provide for access by the Navy Representative to examine the material at the source. Throughout the duration of this work, the Navy Representative may conduct periodic inspections at the quarry and/or visual inspections of the rock delivered to the work site and proposed for use in the construction. Rock failing to meet the specified requirements will be removed from the jobsite by the Contractor at their cost.

2.4 ROCK QUALITY

Import material shall be from sources approved by SES-TECH. Prior to any on-site placement of import materials, the Contractor shall submit test results to SES-TECH for approval.

Armor rock shall be solid, durable, and free from cracks, fractures and other defects tending to destroy its resistance to weather and wave action. Armor rock shall meet the requirements for Degradation Factor and Specific Gravity.

Test	Requirement	Test Method
Degradation factor (material retained on 3/4-inch sieve)	15 minimum	WSDOT 113
Specific Gravity	2.5 minimum	ASTM C 127

2.5 ROCK GRADATION

Armor shall conform to the following gradation requirements:

Percent Passing (by weight)	Typical Dimension (inches)	Weight (pounds)
0-5	15	150-375
10-20	17	150-375
40-60	20	200-500
80-90	22	200-570
100	25	375-625

2.6 ACCEPTANCE OF ROCK MATERIALS

Materials will be inspected at the quarry by the vendor and at the jobsite by the PQCM prior to placement. The Contractor shall be responsible for meeting the rock specifications. Materials that do not meet the size or quality requirements specified above will be rejected and no payment will be made regardless of any general or provisional acceptance of materials from a stockpile or quarry source.

2.7 GEOTEXTILE FABRIC

Geotextile fabric shall be 8 ounces/yard non-woven type Mirafi N-series (180N, 1120N), Amoco 4508, Synthetic Industries 801, or SES-TECH approved equivalent.

PART 3 - EXECUTION

3.1 DEBRIS ON EXISTING SLOPES

Prior to placement of armor rock at the Site, the Contractor shall remove and salvage all debris (e.g. logs, metal, corrugated pipe, concrete debris greater than 1 foot in any dimension, etc.) that would prevent placement of rock per design as determined by SES-TECH.

3.2 PLACING OF GEOTEXTILE

Install geotextile over the 3-foot topsoil layer as indicated on Drawing Number 0031-XS-ALT4 in accordance with the Installer's Quality Control and Installation Manual. Geotextile shall be placed parallel to the slope and successive sheets of geotextile shall be overlapped a minimum of 12 inches. The Contractor shall visually inspect the materials to ensure it complies with the specifications and is not damaged. Repair any damage prior to placement of the overlying materials.

3.3 PLACING OF ARMOR ROCK

The intent of this work is to provide a compact blanket of armor rock over the slope where shown on the drawings. Armor rock shall be placed in a manner that will produce a close-fitting and well-keyed mass of rock with minimum percentage of voids and shall be constructed to the lines and grades shown on design drawings. The armor rock shall be placed over the existing slope to its full course thickness in one operation and in such a manner as to avoid displacing the underlying material. Placing the armor rock by any method likely to cause segregation will not be permitted. The larger rock shall be well distributed and all the rock shall be so placed and distributed so that there will be no large accumulation or areas composed predominately of either the larger or smaller pieces of rock. Hand placing or rearranging of individual rock by mechanical equipment may be required to achieve the results specified above. There shall be no loose or un-keyed rocks on the slope and any un-keyed rock shall promptly be removed or repositioned. A tolerance from slope lines of minus 0 to plus 0.5 foot from top elevations and from slope lines shown on the drawings will be allowed in the finished surface. No allowance will be made for under placement.

In general, all slope protection materials shall be placed from the lower elevations to the higher elevations. The desired distribution of various sizes of stones throughout the mass shall be obtained by selective loading at quarry.

3.4 MAINTENANCE

The Contractor shall maintain the armor rock until accepted by SES-TECH. Any material displaced by any cause shall be replaced to the lines and grades shown at no additional cost to the Navy.

END OF SECTION

SECTION 32 91 19
FISH MIX HABITAT ENHANCEMENT

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

The provisions and intent of the contract, including the General Conditions, apply to this work as if specified in this section.

1.02 SUBMITTALS

Submit the following test reports for the fish mix:

Grain Size Distribution (ASTM D-422-63)

1.03 DESCRIPTION OF WORK

The work includes furnishing all material, labor and equipment necessary for providing imported beach mix ("Charleston Beach" mix). The work shall be performed as shown on the contract drawings and described in this specification section.

1.04 QUALITY CONTROL

Provide testing and inspection service, as required.

PART 2 – PRODUCTS

2.01 GENERAL

Materials shall be of the quantity, size shape, and gradation specified herein.

2.02 BORROW SOURCE CHARACTERIZATION

A. General

Material sources shall be selected by the Contractor and included in the submittal of Proposal and Bid Documents. Suitable test reports must be submitted with the proposal and approved by SES-TECH prior to delivery of materials to the jobsite.

B. Source Identification

Contractor to provide documentation of origin of borrow source material and maps identifying specific location of borrow source.

C. Testing, Reporting and Certification

Submit test sample results for material to be imported. Testing shall include the following:

Grain Size Distribution (ASTM D-422-63)

Acceptance of the fish mix will be based on meeting the grain size distribution specified in Part 2.03 of this specification.

D. Inspection of Materials at the Site

Truckloads of imported material shall be visually inspected upon delivery. Material shall be inspected for presence of foreign, recycled, or reprocessed material. Material may be rejected due to identification of any such material or as a result of substandard test results. Materials may be segregated for testing based on appearance or odor.

2.03 FISH MIX

The fish mix shall not be derived from blasting or crushing operations. This aggregate will be well graded, round, and smooth. It will be free of organic debris and will be obtained from a gravel or sand pit. The grain size distribution for the material will be as follows:

Sieve Size	% Passing (by weight)
2 inch	100
3/4 inch	50-85
US #4	25-45
US #10	20-35
US #40	0-15

2.04 EQUIPMENT

Fish mix can be placed with a shooter truck. Leveling and grading of fish mix is required to form the beach berm and to achieve slopes specified on the drawings.

PART 3 – EXECUTION

3.01 CONSTRUCTION PERIOD

No in-water work may be performed during the fishery closure period, which is February 15 through July 15 of each year.

3.02 FISH MIX PLACEMENT

A layer of fish mix shall be placed adhering to the elevations and slopes as shown on the drawings. A tolerance of plus 6-inches, minus 0-inches shall be maintained on the elevations shown on the drawings.

3.03 MAINTENANCE

The Contractor shall maintain the fish mix until accepted by SES-TECH and any material displaced by any cause shall be replaced to the lines and grades shown at no additional cost to the Navy.

END OF SECTION

BREMERTON NAVAL COMPLEX
BREMERTON, WASHINGTON
TASK ORDER NO. 31
FISH MIX DESIGN DRAWINGS
CONTRACT # N68711-04-D-1104

DRAWING NUMBER	TITLE	TOTAL SHEETS	REVISION
0031-CS-01	TITLE SHEET AND DRAWING LIST	1	0
0031-CS-02	VICINITY AND SITE LOCATION	1	0
0031-GP-ALT4	OUA CHARLESTON BEACH FISH MIX DESIGN PLAN	1	0
0031-XS-ALT4	OUA CHARLESTON BEACH FISH MIX DESIGN CROSS SECTIONS	3	0

ISSUED FOR CONSTRUCTION

DRAWING REDUCED HALFSIZE

DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND NORTHWEST
SILVERDALE, WASHINGTON

BREMERTON NAVAL COMPLEX
BREMERTON, WASHINGTON

OUA CHARLESTON BEACH
TITLE SHEET AND DRAWING LIST

SES-TECH

DESIGNED: ELR		APPROVED	
DRAWN: WDB		SM	
CHECKED: SO			
SIZE: D	SCALE: NA	DRAWING NO. 0031-CS-01	1/1

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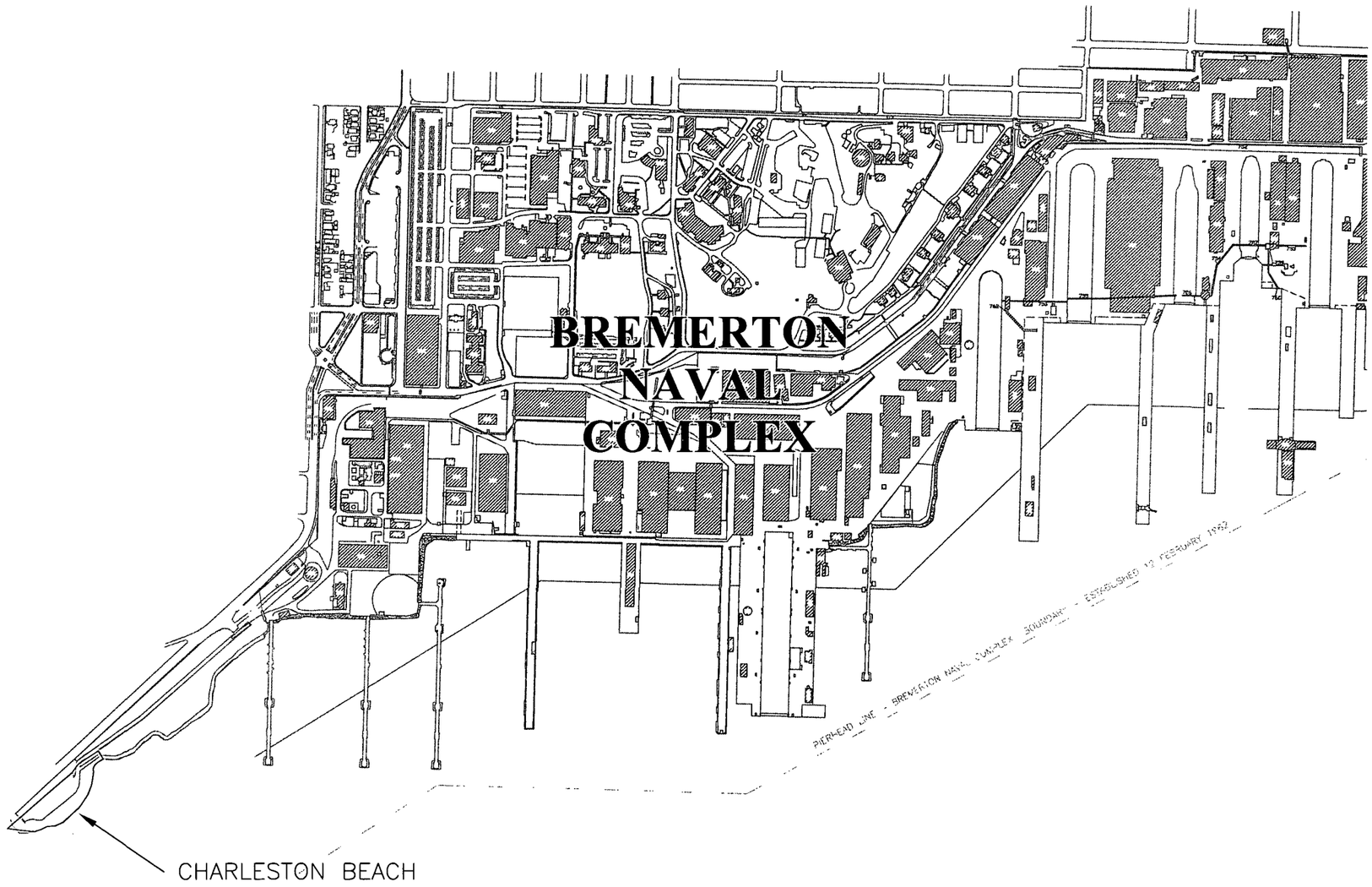

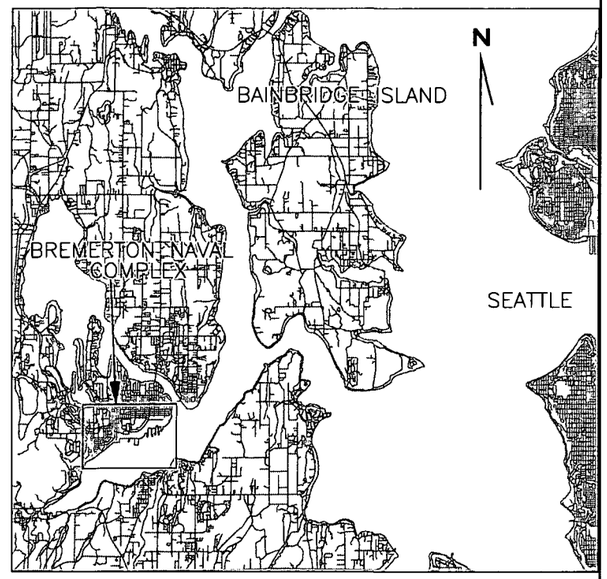

BREMERTON NAVAL COMPLEX
VICINITY MAP

400 0 400
HORIZONTAL SCALE

ISSUED FOR CONSTRUCTION

DRAWING REDUCED HALFSIZE

DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND NORTHWEST
SILVERDALE, WASHINGTON

BREMERTON NAVAL COMPLEX
BREMERTON, WASHINGTON

OUA CHARLESTON BEACH
TITLE SHEET AND DRAWING LIST

SES-TECH

DESIGNED: ELR		APPROVED	
DRAWN: TSB		SO	
CHECKED: SO			
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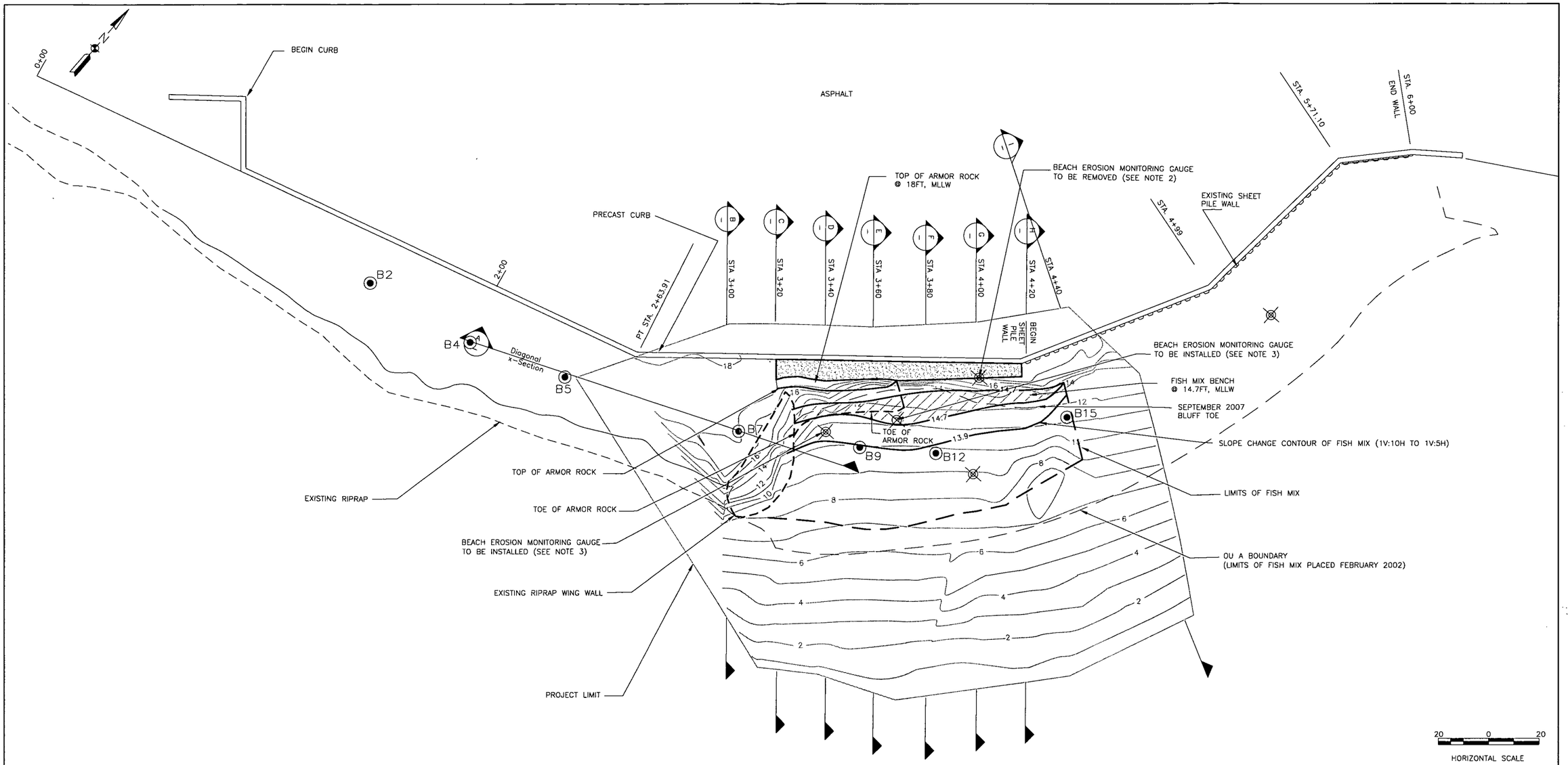

LEGEND:

- BEACH EROSION MONITORING GAUGE
- SECTION A / 0,0 — CROSS SECTION LOCATION
- CONTOUR LINES AS OF SEPTEMBER 2007
- EXISTING RIPRAP
- TOPSOIL
- B2 — EXCAVATED SOIL AND EXPOSED FILL STATION LOCATIONS

NOTES:

1. TOPOGRAPHIC SURVEY CONDUCTED BY SES-TECH ON SEPTEMBER 10, 2007.
2. BEACH EROSION MONITORING GAUGE SHOWN IN TOPSOIL AND ANOTHER GAUGE ADJACENT TO THE EXISTING WING WALL (NOT SHOWN ON DRAWING) WILL BE REMOVED BY CUTTING FLUSH WITH GROUND SURFACE.
3. BEACH EROSION MONITORING GAUGE TO BE INSTALLED FABRICATED FROM 4" PVC PIPE, 6'-0" LONG. SET TOP FLUSH WITH FINISHED GRADE, CONCRETE FILLED. NEW GAUGE IS TO BE PLACED IN FRONT OF TOE OF ARMOR ROCK.
4. PLACE APPROXIMATELY 3 FEET OF TOPSOIL OVER FILL MATERIAL. REDUCE THICKNESS AS REQUIRED TO MATCH TOP OF CURB AND TAPER TO MATCH TOP OF SLOPE.

BREMERTON TIDE DATA	
TIDE DATUM	ELEVATION (FT)
EXTREME HIGH WATER (EHW)	14.67*
MEAN HIGHER HIGH WATER (MHHW)	11.74**
MEAN LOWER LOW WATER (MLLW)	0**
*TIDAL DATA OBTAINED FROM U.S. ARMY CORPS OF ENGINEERS OFFICE AND NAUTICAL SOFTWARE.	
** NOAA STATION ID 9445958, TIDAL EPOCH: 1983-2001	

BASELINE COORDINATES AND BEARINGS	
STATION 0+00	N 206386.79 E 1188674.86
STATION 0+00 TO STATION 2+63.91	N 74°01'52"E
STATION 2+63.91 TO STATION 4+20	N 50°00'26"E

VERTICAL DATUM: MLLW = 0.0 FEET
HORIZONTAL DATUM: NAD83/91
STATION ID: 9445958, BREMERTON, WA
TIDAL EPOCH: 1983-2001

ISSUED FOR CONSTRUCTION

DRAWING REDUCED
HALFSIZE

DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND NORTHWEST
SILVERDALE, WASHINGTON

BREMERTON NAVAL COMPLEX
BREMERTON, WASHINGTON

OUA CHARLESTON BEACH
FISH MIX DESIGN PLAN

SES-TECH

DESIGNED: ELR		APPROVED	
DRAWN: WDB		SM	
CHECKED: SO			
SIZE: D	SCALE: AS NOTED	DRAWING NO. 0031-GP-ALT4	1/1

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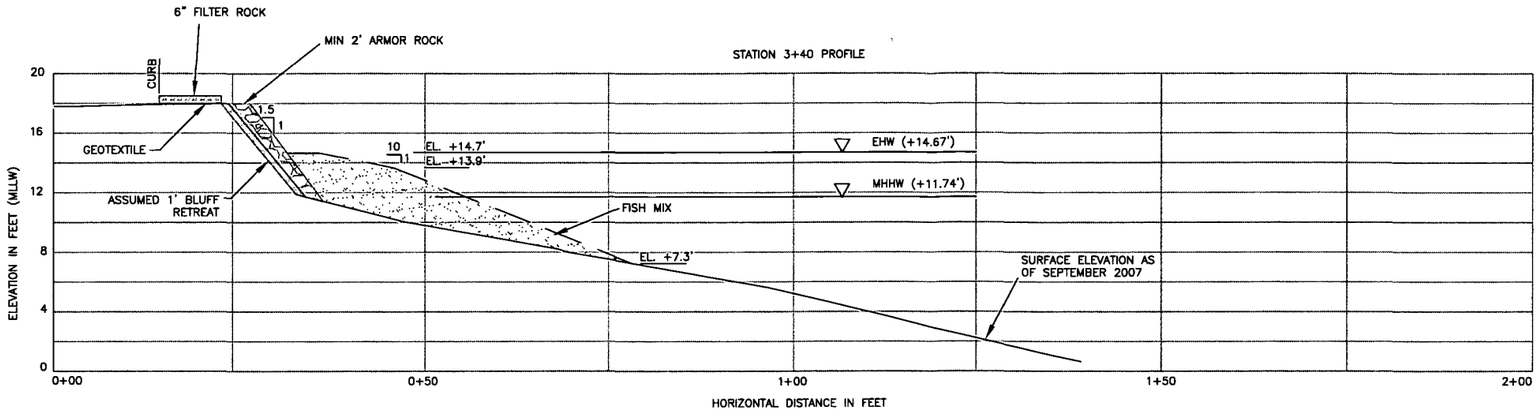
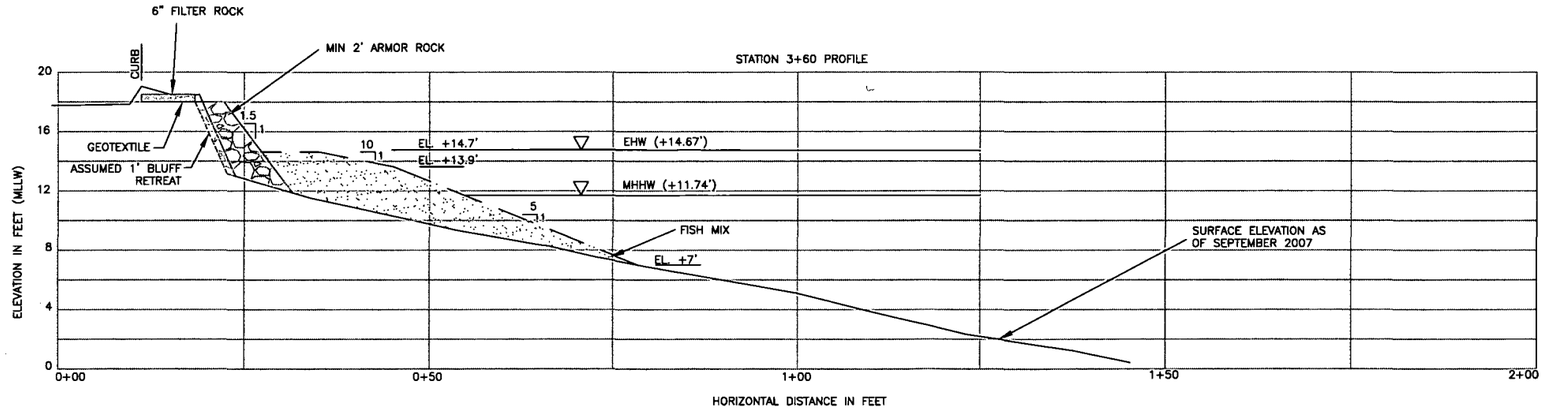
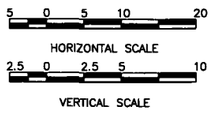


SECTION D/3



SECTION E/3

NOTE:
1. GEOTEXTILE WILL BE PLACED OVER EXPOSED TOPSOIL SURFACE AND SECURED WITH FILTER ROCK; NO VEGETATION WILL BE INSTALLED.
2. ACTUAL VOLUMES AND ELEVATIONS MAY DIFFER THAN INDICATED ON DRAWINGS BASED ON ACTUAL FIELD CONDITIONS. PLACEMENT VOLUME OF ARMOR ROCK AND FILTER ROCK WILL BE LIMITED TO THE VOLUME EXISTING ON SITE (157 TONS OF EACH).
3. EXISTING RIPRAP AND THE NEW ARMOR ROCK WILL BE TRANSITIONED BETWEEN STATION 3+20 AND 3+30. PLACE ONE LAYER OF ARMOR ROCK BETWEEN STATION 3+15 AND 3+20.
4. ARMOR ROCK WALL THICKNESS WILL BE REDUCED GRADUALLY STARTING AT STATION 3+60 AND TAPERED OFF WITH THE EXISTING GRADE BETWEEN STATION 3+60 AND 3+70.
5. ARMOR ROCK WILL BE PLACED ALONG SHORELINE AT A 1V:1.5H SLOPE. PLACEMENT THICKNESS MAY VARY BASED ON ACTUAL FIELD CONDITIONS. NO EXCAVATION WILL BE PERFORMED PRIOR TO PLACEMENT OF ARMOR ROCK.
6. HORIZONTAL EXTENT OF ARMOR ROCK WILL BE ADJUSTED BASED ON ACTUAL EROSION CONDITIONS.



VERTICAL DATUM: MLLW = 0.0 FEET
HORIZONTAL DATUM: NAD83/91
STATION ID: 9445958, BREMERTON, WA
TIDAL EPOCH: 1983-2001

ISSUED FOR CONSTRUCTION

DRAWING REDUCED HALFSIZE

DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND NORTHWEST
SILVERDALE, WASHINGTON

BREMERTON NAVAL COMPLEX
BREMERTON, WASHINGTON

OUA CHARLESTON BEACH
FISH MIX DESIGN CROSS SECTIONS

SES-TECH

DESIGNED: ELR		APPROVED	
DRAWN: WDB		SM	
CHECKED: SO			
SIZE: D	SCALE: AS NOTED	DRAWING NO. 0031-XS-ALT4	1/3

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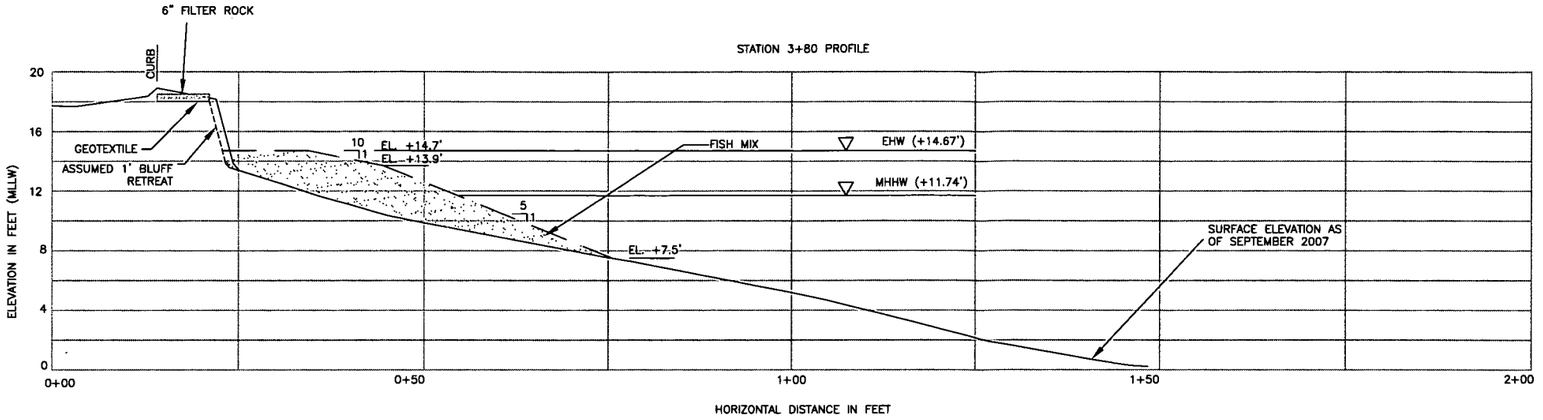
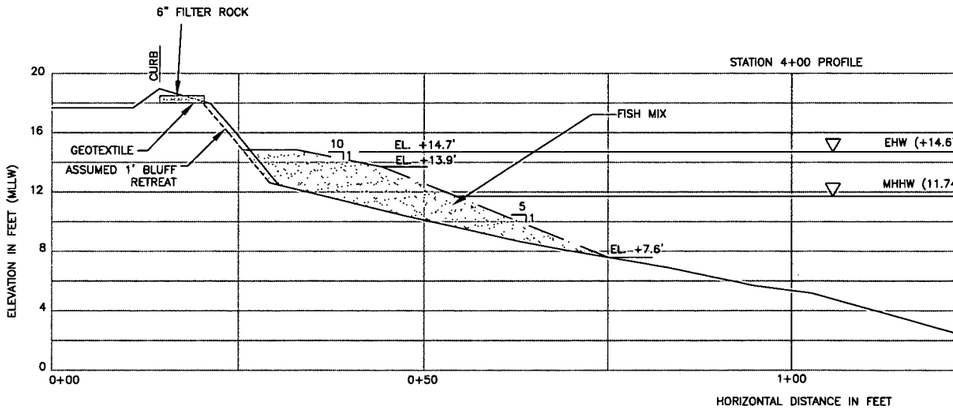


SECTION F 3



SECTION G 3

NOTE:
1. GEOTEXTILE WILL BE PLACED OVER EXPOSED TOPSOIL SURFACE AND SECURED WITH FILTER ROCK; NO VEGETATION WILL BE INSTALLED.
2. ACTUAL VOLUMES AND ELEVATIONS MAY DIFFER THAN INDICATED ON DRAWINGS BASED ON ACTUAL FIELD CONDITIONS. PLACEMENT VOLUME OF ARMOR ROCK AND FILTER ROCK WILL BE LIMITED TO THE VOLUME EXISTING ON SITE (157 TONS OF EACH).
3. EXISTING RIPRAP AND THE NEW ARMOR ROCK WILL BE TRANSITIONED BETWEEN STATION 3+20 AND 3+30. PLACE ONE LAYER OF ARMOR ROCK BETWEEN STATION 3+15 AND 3+20.
4. ARMOR ROCK WALL THICKNESS WILL BE REDUCED GRADUALLY STARTING AT STATION 3+60 AND TAPERED OFF WITH THE EXISTING GRADE BETWEEN STATION 3+60 AND 3+70.
5. ARMOR ROCK WILL BE PLACED ALONG SHORELINE AT A 1V:1.5H SLOPE. PLACEMENT THICKNESS MAY VARY BASED ON ACTUAL FIELD CONDITIONS. NO EXCAVATION WILL BE PERFORMED PRIOR TO PLACEMENT OF ARMOR ROCK.
6. HORIZONTAL EXTENT OF ARMOR ROCK WILL BE ADJUSTED BASED ON ACTUAL EROSION CONDITIONS.

5 0 5 10 20
HORIZONTAL SCALE
2.5 0 2.5 5 10
VERTICAL SCALE

VERTICAL DATUM: MLLW = 0.0 FEET
HORIZONTAL DATUM: NAD83/91
STATION ID: 9445958, BREMERTON, WA
TIDAL EPOCH: 1983-2001

ISSUED FOR CONSTRUCTION

DRAWING REDUCED HALFSIZE

DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND NORTHWEST
SILVERDALE, WASHINGTON

BREMERTON NAVAL COMPLEX
BREMERTON, WASHINGTON

OUA CHARLESTON BEACH
FISH MIX DESIGN CROSS SECTIONS

SES-TECH

DESIGNED: ELR	APPROVED		
DRAWN: WDB	SM		
CHECKED: SO			
SIZE: D	SCALE: AS NOTED	DRAWING NO. 0031-XS-ALT4	2/3

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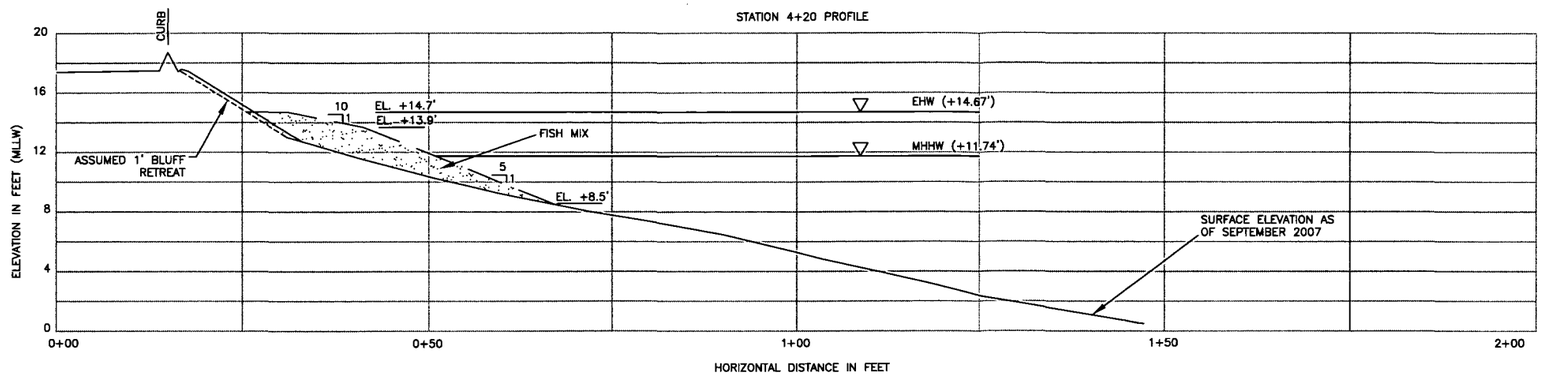
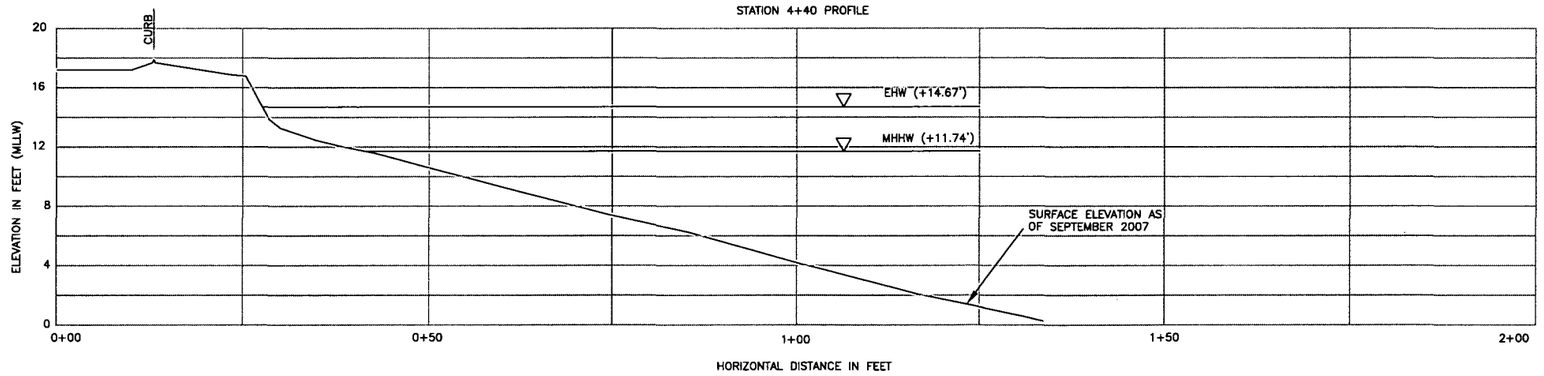


SECTION H/3



SECTION I/3

NOTE:
1. ACTUAL VOLUMES AND ELEVATIONS MAY DIFFER THAN INDICATED ON DRAWINGS BASED ON ACTUAL FIELD CONDITIONS.

5 0 5 10 20
HORIZONTAL SCALE

2.5 0 2.5 5 10
VERTICAL SCALE

VERTICAL DATUM: MLLW = 0.0 FEET
HORIZONTAL DATUM: NAD83/91
STATION ID: 9445958, BREMERTON, WA
TIDAL EPOCH: 1983-2001

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DRAWING REDUCED HALFSIZE

DEPARTMENT OF THE NAVY
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BREMERTON NAVAL COMPLEX
BREMERTON, WASHINGTON

OUA CHARLESTON BEACH
FISH MIX DESIGN CROSS SECTIONS

SES-TECH

DESIGNED: ELR		APPROVED	
DRAWN: WDB		SM	
CHECKED: SO			
SIZE: D	SCALE: AS NOTED	DRAWING NO. 0031-XS-ALT4	3/3

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ATTACHMENT A
FISH MIX DESIGN DOCUMENT

1. Site Background

Between December 2001 and April 2002, a mitigation action was conducted to increase the upper intertidal habitat at Charleston Beach located within the Bremerton naval complex (BNC), Bremerton, Washington. This mitigation action served as an offset for the Military Construction (MCON) Project P-341, which provided for the replacement of Pier D. A part of this mitigation included removing the riprap armor wall at Charleston Beach and replacing it with a soft bank sloped beach covered with fish mix gravel.

Washington State Department of Ecology deemed that this soft beach was protective according to the Record of Decision (ROD) for Operable Unit A (OU A) as long as "scouring is not excessive". As of April 2007, the section of the soft beach between Station 3+00 and 4+20 (Figure 1) has been scoured to the extent that the fish mix gravel is mostly gone and the soft embankment that makes up the edge of OU A along Charleston Beach has been eroded back into the fill, thus initiating release of fill debris onto the beach (Sealaska Environmental Services-Tetra Tech EC, Inc. Joint Venture [SES-TECH] 2007).

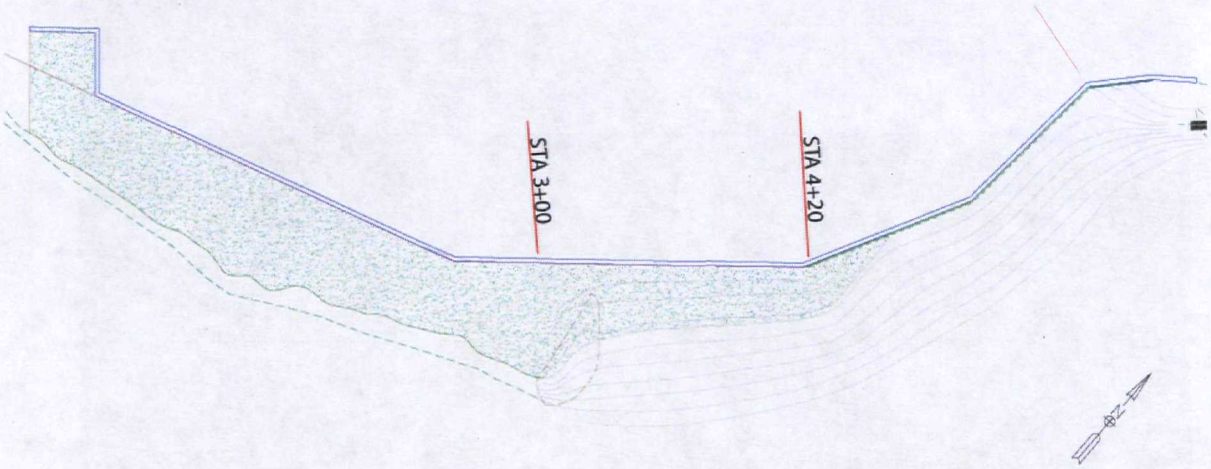

Figure 1 Location of Stations 3+00 and 4+20 in Charleston Beach, February 2002

As a result of the erosion, the Navy had intended to perform an emergency repair action in November and December 2007, prior to the 2008 storm season. However, inspection of the beach at the start of construction activities revealed the presence of surf smelt eggs. In consultation with the Stakeholders, it was mutually agreed to halt construction and postpone the repair action until August 2008 when surf smelt spawning is at its lowest. It was also agreed that the repair action would be performed only as an interim repair action to stabilize the bluff and enhance the beach habitat while the Stakeholders develop a long term solution to control the erosion and protect the marine habitat in accordance with the OU A ROD. In the meantime, plastic sheeting has been placed over the shoreline and silt fence has been installed in front of the shoreline to minimize erosion until resumption of the interim repair action. The purpose of this study is to design the fill gradation and profile necessary to minimize the erosion into Sinclair

Inlet and to provide a functionally performing fish mix beach during development of the long term repair action.

Prior field observations conducted during winter months on the behavior of the sediment transport in the vicinity of Charleston Beach indicated a weak west to east movement with relatively low energy acting upon the beach (Foster Wheeler Environmental Corporation [FWEC] 2002).

Monitoring of the site conducted in February 2006 indicated that the fish mix placed in 2002 had eroded 17 inches and 37 inches at the beach gauge and at the embankment gauge, respectively (SES-TECH 2006), with additional erosion observed subsequently. Locations of the gauges are shown in Figure 2. Profile surveys conducted by SES-TECH in September 2007 indicate that the beach has slopes ranging from 1V:7.5H to 1V:8.3H (vertical [V]:horizontal [H]). Most of the higher sandy beach mix material has eroded from its original condition in 2002 and the gravel material has been sorted within the beach area.

Figure 2 Charleston Beach, July 2007

2. Beach Design

As part of the interim repair action, the design for the new fish mix to be placed at Charleston Beach aims to provide temporary repair of the scoured beach section and select a grain size distribution supportive of forage fish spawning.

Five alternatives were considered to satisfy the fish mix replenishment requirements. The first three alternatives included placement of an armor rock revetment to permanently stabilize the shoreline with either two variations of composite beach (mixed sand-gravel beaches) or one variation solely of fish mix. The fourth and fifth alternatives included temporary stabilization of the shoreline with limited placement of armor rock or filter rock followed by fish mix placement.

Mixed-sediment beaches are found where the primary source of sediment to the littoral system contains a mixture of sand and gravel (Puget Sound Nearshore Partnership [PSNP] 2006). The term "mixed beach" is applied where the substrate is formed by a homogeneous mixture of sand and gravel, and also where the foreshore comprises gravel with a sandy low-tide terrace (Pontee et al. 2004). The terms "Fish Rock", "Fish Mix", "Habitat Mix" and "Beach Mix" will be used to define the gravel mix that is of suitable size for bait fish spawning (pea gravel). This material creates a more natural environment for the animals that live in the sediments and contributes to the formation of an Essential Fish Habitat (EFH).

To create a dynamically stable beach profile, a composite beach design was considered. The general configuration of a composite beach consists of a layer of fish mix placed over gravel. The presence of sand within the mixed sand-and-gravel beach acts to reduce the infiltration in the beach face and acts to dissipate the energy of the wave swash. Composite beaches combine the dissipative element of a sandy foreshore and the reflective gravel backshore (Komar 2007). The resulting uprush and downrush velocities are more symmetrical in the area of higher sand content, which results in a flatter slope in the sandy forebeach area than that found in solely gravel beaches. The composite beach design was developed by:

1. Establishing the basis of design,
2. Determining suitable fish mix and gravel beach design gradation curves,
3. Determining a dynamically stable beach profile (berm elevation and beach slopes).

After the beach profile was developed, the expected erosion rates were calculated and the suitability of the designed beach mix gradation to meet the fish mix environmental objectives was evaluated. Based on the design, five alternatives of the beach profile were developed. The recommended alternative based on project constraints and Stakeholder input was then selected.

2.1 Beach Design Criteria

The wind and wave analysis previously performed at the site (FWEC 1999) was used as the basis of design for the interim repair action at Charleston Beach. The revised beach design incorporated the criteria of a 10-year storm event (for the fish mix design) and a 25-year storm event (for the gravel portion) with winds blowing at 215 degrees from the southwest (SW). Analysis of the tide levels for each recurrence interval is not available; therefore, mean higher high water (MHHW) (11.74 feet above mean lower low water [MLLW]) was used as a conservative design water level.

Table 1 Extreme Value Statistics for Wind and Waves for Charleston Beach. Wind Direction 215° (SW)

Recurrence Interval (years)	Wind Speed (mph)	Hs (ft)	T(s)	Lo (ft)
10	38	1.9	2.5	33.0
25	50	2.5	2.9	42.8
50	58	3.0	3.1	77.5

mph – miles per hour
Hs – significant wave height
T – period
Lo – wave length
s – seconds
ft - feet

2.2 Determination of Fish Mix Gradation

Myers Biodynamic (FWEC 2002) reported that the surficial sediments (0 to 3 inches below mudline) were coarser than the sediments below 3 inches in the substrate profile at the same location, and that the gravel content was higher in the upper beach face. This distribution of sediment (Figure 3), as noted in the report, is typical of mixed sand and gravel and composite beaches. This gradation was compared with the typical gradation of natural Puget Sound Beaches (Simpson et al 2007) along with material placed at the BNC during previous shoreline restoration projects (TO 17 Types I and II material, Fish Mix – Missouri Parking Lot, and Charleston Beach Fish Mix) (see Figure 3). The habitat mix used by the Navy at a nearby facility (labeled as "Floral Beach Fish Mix") was also included for comparison purposes. The shaded area in Figure 3 shows the recommended design gradation range for the habitat mix (fish mix) based on natural conditions at Charleston Beach and the typical spawning substrate for surf smelt in Puget Sound. The selected design gradation range for fish mix is shown in Table 2.

Table 2 Gradation of Design Fish Mix

Sieve Size	Sieve Opening (mm)	Description	%Passing
2"	50	Coarse gravel and smaller	100
¾"	19	Pea gravel and smaller	50-85
#4	4.75	Coarse sand and smaller	25-45
#10	2	Medium sand and smaller	20-35
#40	0.425	Fine sand and smaller	0-15

Gradation of the gravel portion of the composite beach alternatives were designed by comparing natural Puget Sound beach gravel, and TO17 Types I and II material (Figure 4). Gradation of the filter rock that would be placed under the armor rock portion of the proposed permanent revetment wall is also included in Figure 4 for reference. The recommended design gravel foreshore is presented in Figure 4. The design gravel foreshore is specified as rounded fine to coarse gravel within ¾-inch to 2-inch size. Both the filter rock and design gravel foreshore have the same D_{50} value (particle diameter corresponding to 50 percent finer in gradation curve) and similar gradation; however, the filter rock material is of sub-angular nature. Both gravel-size material (design gravel foreshore and filter rock) fulfill a different purpose in the beach design; filter rock for erosion protection and gravel foreshore for composite beach habitat.

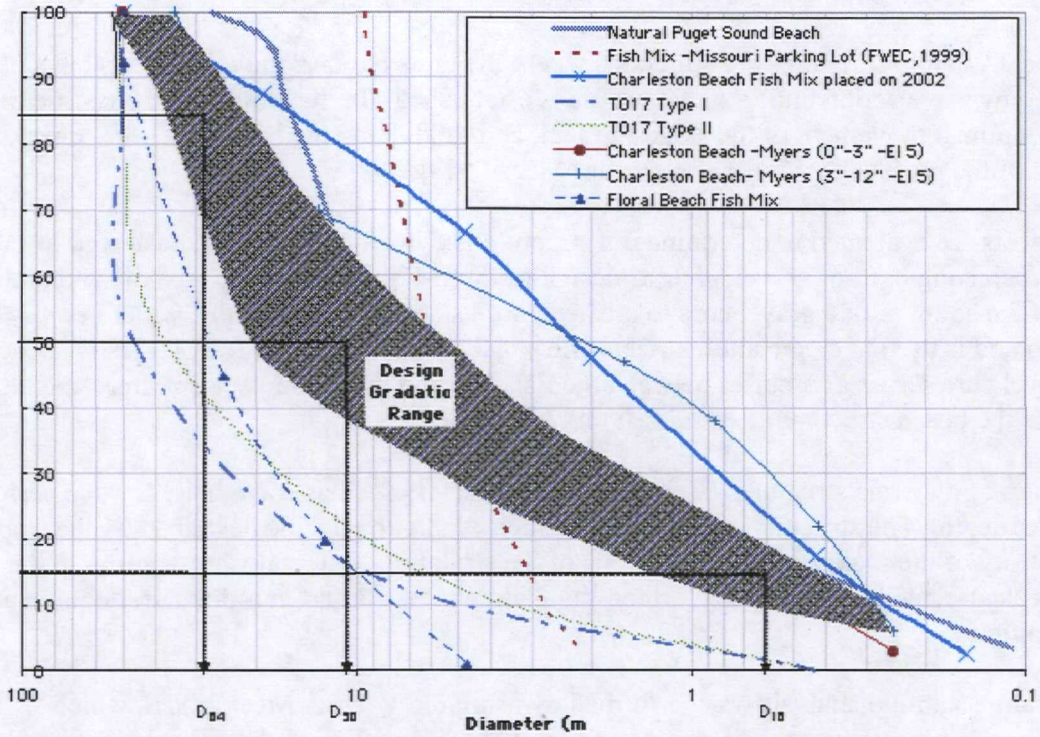

Figure 3 Fish Mix Gradation Comparison

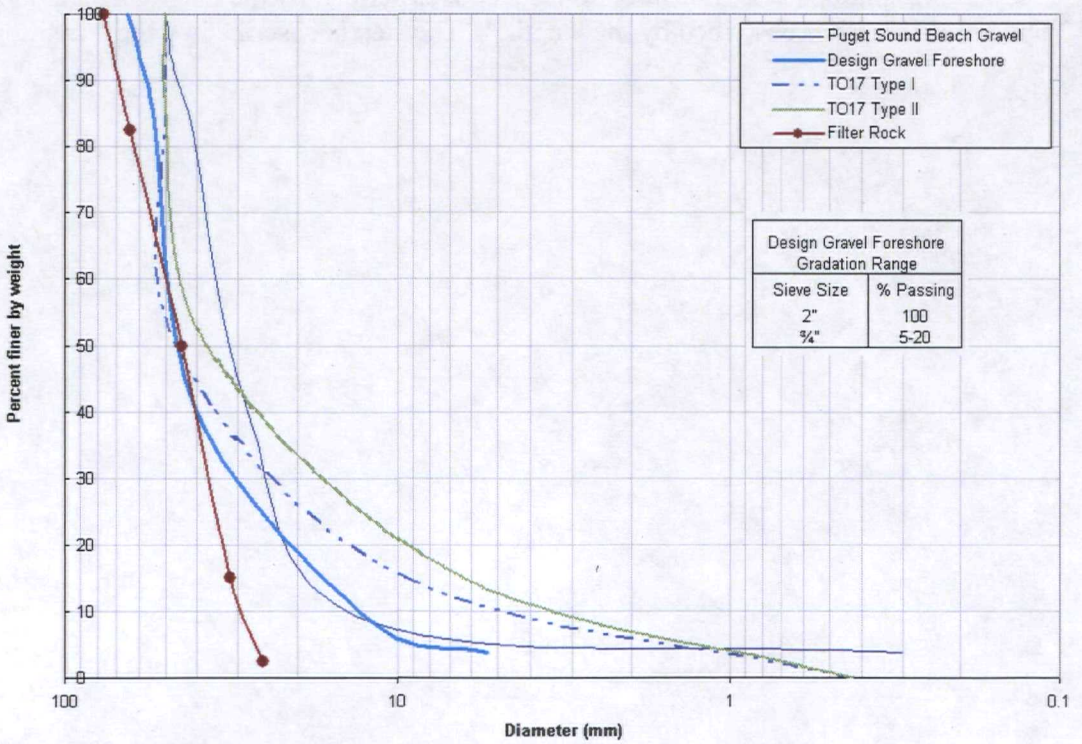

Figure 4 Gravel Beach Gradation Comparison

2.3 Design of Dynamically Stable Beach

Dynamically stable structures are structures where the units (stones, gravel or sand) have been displaced by wave action until a stable profile is established. In dynamically stable structures, there is minimal movement of the stones, gravel, and sand along the beach (i.e., the transport capacity of the profile is diminished [Van der Meer 1988]).

Two aspects are evaluated to determine if a structure is dynamically stable: the design of the upper beach composed of gravel, and the design of the fish mix face composed of sand and pea gravel. The addition of a gravel core to create a more stable structure with a wider berm is analyzed and is used to create alternative profiles that could be suitable for Charleston Beach. The gravel core serves as a buffer between the fish mix and the armor rock structure and also stabilizes the beach structure after the fish mix has eroded away.

Evaluation of dynamic structures takes into account factors such as wave height, wave period and water depth. The structural parameters for such evaluation can be described by the slope, the mass density of the rock, and the dimensions of the structure. External water motion in the structure is affected by the breaking or non-breaking waves, run-up, run-down, reflection, and overtopping.

The dynamic stability analysis was performed by using the Van der Meer model, which evaluates and characterizes the formation of a profile. The equilibrated profile determined by using parameters on a 1V:5H initial slope is shown in Figure 5. The beach crest is described by the height, h_c, and the length, l_c. The transition to the step is described by the height, h_s, and the length, l_s. The run-up length is described by the length, l_r. The step is described by the transition height, h_t.

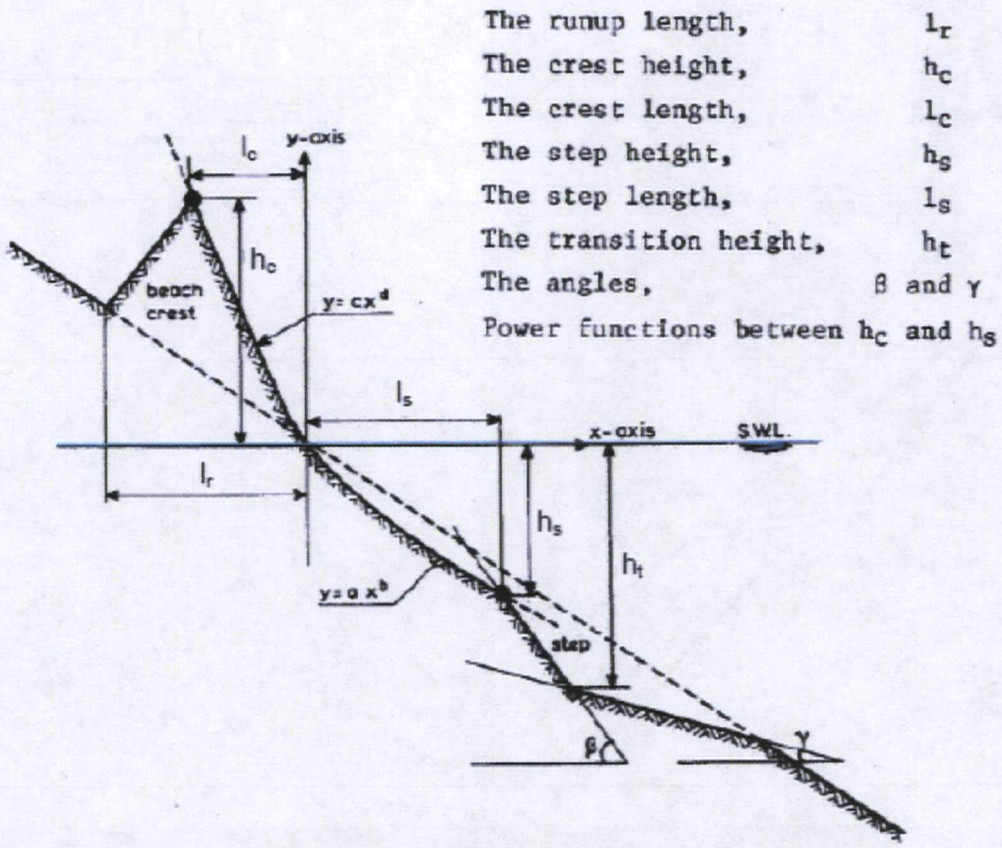

Figure 5 Schematization of Equilibrated Profile on 1V:5H Slope (Van der Meer 1988)

Gravel Slope Dynamic Stability

The dynamic stability analysis was applied to the recommended gravel type material presented in Figure 4 in a composite beach with a design storm event of 25 years at various initial slopes. Based on the gradation analysis for the gravel, the design D_{50} (particle diameter corresponding to 50 percent finer in gradation curve, Figure 4) is 1.81 inches (46 millimeters [mm]). The water level used to evaluate the profiles was set at MHHW, 11.74 feet above MLLW. The results from the Van der Meer model for the gravel beaches are tabulated in Table 3.

Table 3 Equilibrated Gravel Beach Components

	Initial Slope 1:n		
Gravel Beach Profile	**5**	**6**	**7**
Runup Length (lr), ft	10.6	10.6	10.6
Crest Length (lc), ft	4.7	4.7	4.7
Crest Height (hc), ft	2.9	2.9	2.9
Step Length (ls), ft	10.1	10.1	10.1
Step Depth (hs), ft	2.2	2.2	2.2
Step Slope (cot β)	2.6	2.9	3.2
Transition Slope (cot γ)	10.0	12.0	14.0
Transition Depth (ht), ft	4.4	4.4	4.4
Transition Length (lt), ft	15.7	16.4	17.1

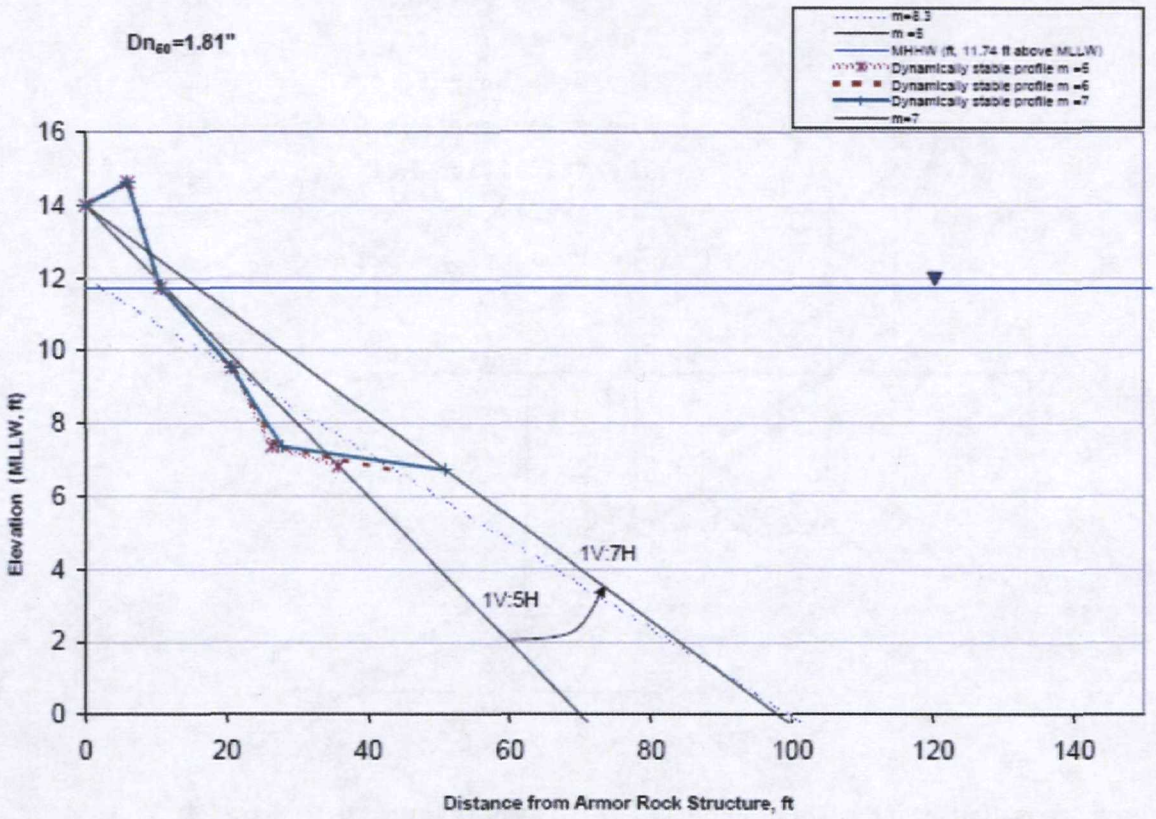

Figure 6 Dynamic Stable Gravel Profile

The crest elevation obtained for the gravel component through the dynamic stability analysis was 14.6 feet MLLW. This value was obtained by adding the resultant h_c=2.9 feet to the design water level of MHHW. During the design stage, the berm elevation was placed at or above the crest elevation obtained through this analysis. The gravel material was then placed in the berm and under the fish mix foreshore. The gravel material located under the fish mix is to be maintained at the currently existing approximate slope of 1V:8H. The equilibrated profiles are shown in Figure 6.

Fish Mix Dynamic Stability

The fish mix slopes were designed based on a 10-year storm event. Equilibrated profiles were evaluated at various initial slopes. The design D_{50} is 0.4 inches (10.2 mm). Similar to the gravel slope stability analysis, the water level used to evaluate the profile was set at MHHW. The results from the Van der Meer model for gravel beaches were applied to the fish mix analysis performed in this study and tabulated in Table 4. The equilibrated profiles are shown in Figure 7.

Table 4 Equilibrated Fish Mix Components

Fish Mix Profile	Initial Slope 1:n		
	5	6	7
Runup Length (lr), ft	9.7	9.7	9.7
Crest Length (lc), ft	4.8	4.8	4.8
Crest Height (hc), ft	2.2	2.2	2.2
Step Length (ls), ft	9.2	9.2	9.2
Step Depth (hs), ft	1.7	1.7	1.7
Step Slope (cot β)	2.6	2.9	3.2
Transition Slope (cot γ)	10.0	12.0	14.0
Transition Depth (ht), ft	3.3	3.3	3.3
Transition Length (lt), ft	13.5	14.0	14.5

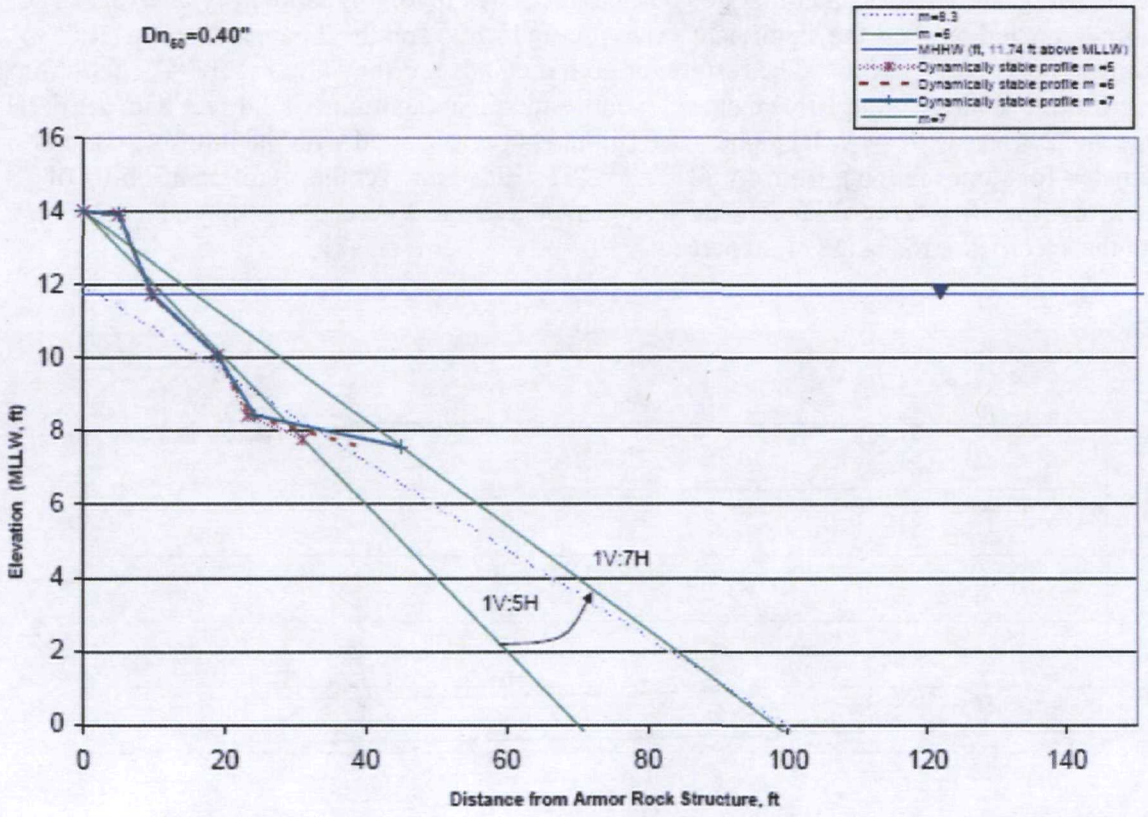

Figure 7 Dynamic Stable Fish Mix Profile

The crest elevation obtained for the fish mix component was at or above 13.9 feet MLLW. This value was obtained by adding the resultant h_c=2.2 feet to the design water level of MHHW. Based on the analysis shown in Table 4, the initial slope for the fish mix was set to 1V:5H so that the resulting equilibrated slope would reach 1V:10H, close to the approximate existing beach slope of 1V:8H.

Gravel-Fish Mix Transition Elevation

The location of the gravel-fish mix transition elevation was determined by evaluating wave run-up, the maximum vertical extent of wave uprush on a beach. The normal wave run-up elevation on the beach serves as an appropriate point for the transition of the fish mix on the lower slope and the gravel on the upper slope. In gravel beaches, the wave run-up percolates into the beach, thus reducing the extent of any run-up and reducing the volume backwashed. As wave run-up and seepage through permeable slopes are still not well quantified in literature, SES-TECH calculated the estimated wave run-up through a synthetic and intuitive method (Kobayashi and de los Santos 2007) and through a quantified understanding of run-up on impermeable slopes (Hughes 2005).

For this evaluation, run-up analysis on impermeable slopes was limited to slopes no flatter than 1V:4H. For slopes flatter than 1V:4H, the intuitive method requires a more comprehensive analysis of wave statistics and other geometrical measures involving laboratory analysis. The intuitive method predicts the significant wave run-up (R1/3) and the 2 percent run-up (Ru2%) within an error of 20 percent. The results for both methods are shown in Figure 8. The run-up in impermeable slopes for the 10-year storm event results in a maximum of 3.4 feet with a 1V:2H slope and 2.1 feet with a 1V:4H slope. The run-up values obtained with the intuitive method estimated for slopes ranging from 1V:4H to 1V:7H yielded an average significant run-up of 2.1 feet with a specified error of 20 percent; whereas the average 2 percent run-up yielded 2.4 feet with the specified error range of 20 percent.

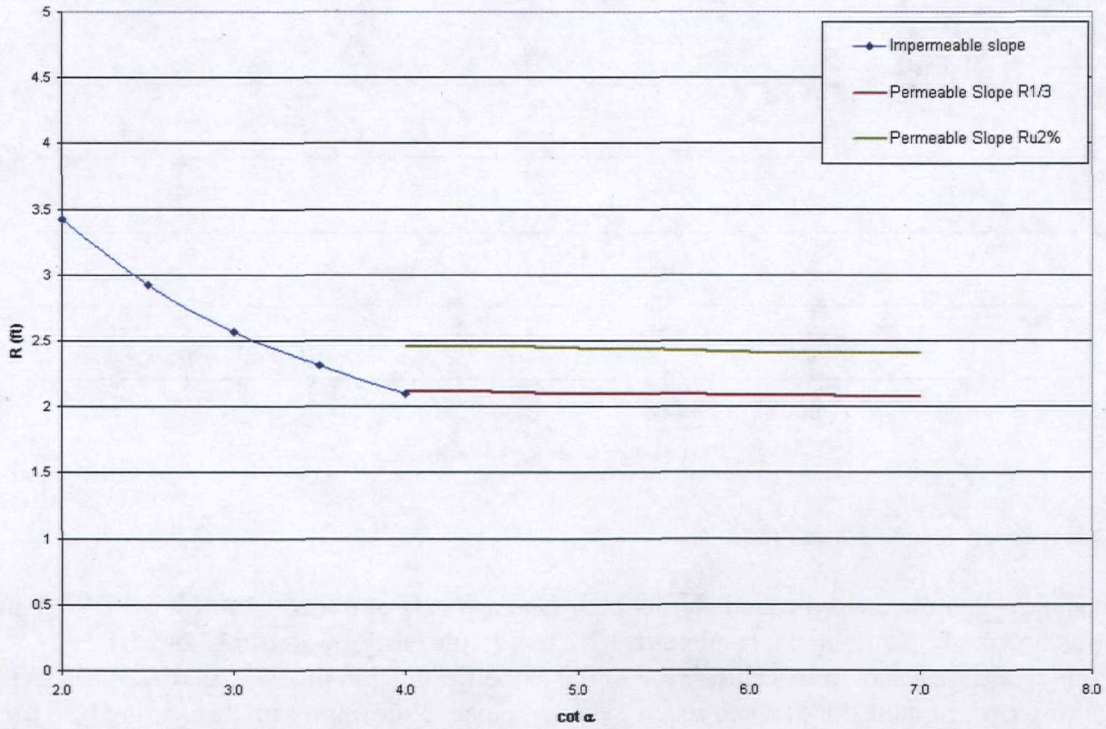

Figure 8 Run-up Estimates for the 10 Year Storm Event

Given the limitations provided by the impermeable and permeable slope run-up analysis, SES-TECH used the smaller range of the 2 percent of maximum run-up using the intuitive method to set the limits of run-up in the fish mix foreshore (13.7 feet MLLW). Any value calculated below this number would increase the uncertainty of the method. The value obtained though the synthetic method was similar to the 13.9 feet MLLW berm elevation yielded with the dynamic stability method. Therefore, 13.9 feet MLLW was used as the limit for the berm elevation in all design alternatives.

A separate analysis of equilibrated profiles for beaches with dissimilar sediments (Powell 1993) was also performed. Given the mean gradation characteristics for the fish mix (D_{84}, D_{50} and D_{16}) obtained from Figure 3, and design wave parameters, the following new equilibrium slopes: a) 1V:9.8H for the gravel, and b) 1V:16H for the fish mix were obtained. The equilibrated profile predicted for the fish mix is flatter than the actual conditions of the beach given the generally smaller sediment characteristics of the fish mix as compared to the natural beach. In the design stage, a steeper value (following the dynamic stability method) was used so that the equilibrated profile flattens to a range between the approximate existing beach slope of 1V:8H and the predicted slope of 1V:10H (Table 4).

Some Considerations on Fish Mix Performance

The spatial redistribution of sediments in fish mix environments has been documented in laboratory experiments (Mizutani et al 2004) and in observations in several beaches around the United Kingdom (Austin and Masselink 2006, Buscombe and Masselink 2006, Horn and Walton 2007, Austin and Buscombe 2008). Infiltration rates are an important factor in the development of the beach profiles along with the thickness of the mixed beach layer (Mizutani et al 2004). Changes in the distribution of sediments in the berm crest area will occur with time, but they are not expected to affect the performance of the fish mix as habitat in the short term. In the long term, however, sediments of larger size are likely to merge with the larger size fish mix material moved to the top by onshore wave forces.

2.4 Expected Erosion Rates

The expected erosion rates were evaluated for the proposed fish mix design. Given the higher percentage of fine material in fish mix, overfill ratios were calculated applying models for beaches with higher percentages of sand. It is expected that the beaches will reshape and obtain a higher steeper beach composed of coarse sand and gravel and a low tide terrace composed of silt and sand.

James (1975) established a technique that considers the differences between the replenished sediment and native materials to predict how often renourishments would be required. The overfill ratio, R_J, defines the ratio at which the recharge (fill) material is eroding. The overfill ratio for Charleston Beach was calculated with a typical factor of $\Delta = 1.0$ (called the winnowing function which varies between 0.5 to 1.5 depending on the native and refill gradations). The resultant refill factor $R_J=1$, falls within the limits of the stable/unstable range, indicating that the material would erode, causing the beach to return to its pre-construction condition. Thus, gradation of the recharge material for beach fill must be coarser than the existing material. A

mean diameter of 1.5 times the natural beach material is recommended for the recharge material to reduce the renourishment frequency (Newman 1974). Because the current design gradation is coarser than the existing material, the erosion rates at the beach restored with the recommended fish mix are expected to be slower than the rate experienced from 2002 through 2006. With the coarser material, the anticipated transport rate would be less than previously experienced if the beach were to be exposed to the same dynamic conditions.

2.5 Suitability of Beach Substrate to Meet Fish Mix Environmental Objectives

The considered fish mix composition was also evaluated relative to what was considered suitable for fish use in the past at Charleston Beach and what is known about spawning substrate characteristics needs. Based on the presence of surf smelt eggs in November 2007, the beach substrate characteristics considered suitable for spawning surf smelt was included in the evaluation. Myers Biodynamic's recommendations for substrate placement at this site (FWEC 2002) were also evaluated.

Spawning substrate for surf smelt in Puget Sound has been described as coarse sand or pea gravel (Herrera Environmental Consultants [Herrera] 2005). It was also reported that the range of substrate typically used is 1 mm to 7 mm in size (Herrera 2005). Surf smelt also typically spawn high in intertidal areas, between mean tide level and MHHW, so surface and near surface substrate in this region is of most concern.

The characteristic of various substrates present are shown in Table 5. The recommended design gradation range for the fish mix closely follows the natural Charleston Beach gradation as well as typical natural Puget Sound beaches. Ideally, nourishment material should reasonably match close to the native material (Dean 2002).

Table 5 Average Gradation Range of Various Beach Substrates

Various Substrates	Gradation Range (% of substrate by weight)	
	Sand to pea gravel (4.75 mm-19 mm)	Typical surf smelt substrate reported (1 mm-7 mm)
SAIC (2001) Recommended	65-90	35-75
Charleston Beach Installed (2002)	65-90	35-75
Previous Charleston Beach (Myers)	35-60	20-45
Natural Puget Sound Beach	35-95	25-45
Floral Beach Fish Mix (2007)	0-25	0-10
Design Fish Mix (see Figure 3 - Design Gradation Range)	25-85	20-45

SAIC – Scientific Applications International Corporation

3. Design Alternatives

A dynamically stable beach profile and a gradation of fish mix were designed to replenish the eroded fish mix at Charleston Beach. Based on the results of analysis detailed above, a total of five beach mix profiles were developed. Three profiles were developed based on the assumption that a permanent armor rock revetment would be constructed to stabilize the eroding shoreline.

Two profiles were developed based on the assumption that a temporary repair action would be performed in August 2008 followed with implementation of a long term solution at a later date.

3.1 Design Alternatives 1, 2, and 3

Alternatives 1 and 2 are composite beaches that contain a gravel core creating a wider berm and footprint for the total beach (Drawings 0031-GP-ALT1 through 0031-XS-ALT2). Alternative 3 corresponds to fish mix material only (Drawings 0031-XS-ALT3). The approximate volumes of gravel and fish mix required based on the three alternatives are summarized in Tables 6 through 8.

For this interim repair action, the completed beach must be able to sustain surf smelt spawning as well as minimize erosion. The fish mix must also be designed with a material acceptable for fish forage species. Composite beach alternatives (Alternatives 1 and 2) provide a better dynamically stable beach profile as compared to the beach profile formed only by fish mix (Alternative 3) while providing similar habitat for spawning substrate for surf smelt. However, based on budgetary constraints, the Navy is currently limited to placement of approximately 365 cubic yards (CY) of fish mix material.

As shown in Tables 6 and 7, Alternatives 1 and 2 exceed the 365 CY limitation. Alternative 1 requires a total of 715.2 CY of gravel and fish mix material. Alternative 2 requires a total of 444.6 CY of gravel and fish mix material. Alternative 3 is not as dynamically stable as compared to the composite beach alternatives, but provides the substrate required for sustaining surf smelt spawning and fish forage species. As compared to Alternatives 1 and 2, Alternative 3 will require more frequent renourishment of the beach, but at a lesser rate than experienced from 2002 through 2006.

Table 6 Alternative 1 Volumes (CY)

	Gravel	Fish Mix
Sta 3+40	85.6	115.6
Sta 3+60	54.1	74.8
Sta 3+80	57.0	74.8
Sta 4+00	54.1	74.8
Sta 4+20	50.4	74.1
	301.1	414.1

Table 7 Alternative 2 Volumes (CY)

	Gravel	Fish Mix
Sta 3+40	48.3	77.8
Sta 3+60	25.9	51.9
Sta 3+80	33.3	51.9
Sta 4+00	29.6	51.9
Sta 4+20	18.5	55.6
	155.7	288.9

Table 8 Alternative 3 Volumes (CY)

	Gravel	Fish Mix
Sta 3+40	-	102.2
Sta 3+60	-	68.1
Sta 3+80	-	74.1
Sta 4+00	-	71.1
Sta 4+20	-	58.5
	-	374.1

Alternatives 1, 2, and 3 were developed as a long term solution for stabilizing the eroding shoreline. However, these three alternatives could be modified to exclude the armor rock revetment for consideration as a temporary solution while the Stakeholders perform further beach studies to develop a long term solution that best controls the erosion and protects the marine habitat at Charleston Beach. Alternatives 1 and 2 are composite beaches with gravel foreshore and fish mix, and Alternative 3 involves the placement of only fish mix. Based on the Navy's budgetary constraints, the implementation of Alternatives 1 and 2 would require additional budget to purchase material needed for the gravel foreshore portion of the composite beach. In comparison to Alternatives 1 and 2, Alternative 3 (fish mix only) is not as dynamically stable. Further, fish mix itself does not provide any shoreline erosion protection. The bluff would be exposed to erosive forces at a faster rate under Alternative 3 than the other alternatives.

3.2 Design Alternatives 4 and 5

As the presence of surf smelt eggs postponed the performance of repair activities at Charleston Beach from November 2007 to August 2008, 157 tons (approximately 65 CY) each of armor rock and filter rock are currently on site. These import materials were intended to be used in the construction of a permanent armor rock revetment to stabilize the shoreline. Alternatives 4 and 5 were developed to beneficially use a portion of the import material in construction of the interim repair action.

During weekly site inspections since December 2007, erosion has occurred along the shoreline, the full extent of which will not be known until removal of the plastic sheeting in August 2008. As the extent of erosion is unknown at this time and to maximize the use of the import material for the interim beach repair, two alternatives were evaluated:

- Alternative 4 - Retreated Bluff. Assumes 1.0 foot bluff retreat
- Alternative 5 - Exposed bluff with limited toe protection

Alternative 4 involves the placement of armor rock and fish mix material (Drawings 0031-GP-ALT4 through 0031-XS-ALT4). With this alternative, the armor rock is considered to be an extension of the existing riprap wing wall with its extent restricted by the amount of material presently available. Based on observations, the bluff erosion is most severe adjacent to the existing riprap wall, and some armoring behind the fish mix placement is important to provide protection. The armor rock will be placed in the southwestern corner of the soft-beach shoreline to temporarily minimize the erosion from this particular area. The armor rock will be placed in a manner that will produce a close-fitting and well-keyed mass of rock with minimum percentage

of voids. Filter rock will not be used to fill in voids as this material is unsuitable for habitat development. Fish mix will be placed along 120 lineal feet of shoreline and will overlap onto the armor rock.

As the interim repair action provides a temporary solution while Stakeholders develop a long term solution to control the erosion and protect the marine habitat at Charleston Beach, no vegetation will be placed on top of the bluff. Topsoil will be placed to provide an average 3-foot thick cover over the fill material overlain with placement of geotextile fabric secured with a 6-inch thick layer of filter rock.

The volumes of material required to be placed based on an estimated bluff erosion of 1 foot as compared to the September 2007 site survey are shown in Table 9.

Table 9 Alternative 4 Volumes (CY) – 1-foot Erosion

	Armor Rock	Filter Rock to Secure Geotextile	Fish Mix
Sta 3+40	25.8	5.2	104.6
Sta 3+60	45.3	9.1	78.0
Sta 3+80	-	-	75.9
Sta 4+00	-	-	68.5
Sta 4+20	-	-	40.3
	71.1	14.2	367.4

Alternative 4 provides a hardened bluff behind the fish mix beach deposits that will minimize further bluff erosion beyond the present position that, in turn, will minimize impacts to the upland parking lot. After a few years, the beach is expected to flatten out due to erosion and will develop to an equilibrated profile. However, with the presence of the longer stretch of armor rock wrapping around and extending towards the northeastern part of the beach from Station 3+20 to Station 3+70, it is expected that the erosion will progress in a northeasterly direction as a result of the hardening of the upper portion of the beach.

The beach profiles for Alternative 5 include the placement of filter rock material as bluff protection with fish mix placed along 120 lineal feet of shoreline. As the median grain size (D_{50}) of the filter rock is similar to that of the design gravel foreshore (see Figure 4), the filter rock can be utilized to provide some protection to the toe of the bluff. The filter rock, however, should not be placed as a gravel base or as a layer beneath the fish mix as the sub-angular nature of the filter rock is not recommended for use as spawning material (WDFW 2004).

For this alternative, the placement of filter rock has been limited to 18 feet from the top of the bluff based on reach constraints of the excavator that will be on site. As such, the filter rock was designed to be placed closer to the bluff with a maximum slope of 1V:1.5H. The volumes of material to be placed for Alternative 5 are shown in Table 10. As the erosion is most severe between stations 3+20 and 3+60, the design has been developed to allow more material to be placed in this area.

Table 10 Alternative 5 Volumes (CY)

	Armor Rock	Filter Rock to Secure Geotextile	Filter Rock as Gravel Base	Fish Mix
Sta 3+40	-	5.2	23.9	123.9
Sta 3+60	-	3.0	10.9	79.0
Sta 3+80	-	2.9	12.6	76.3
Sta 4+00	-	2.5	9.1	64.5
Sta 4+20	-	-	5.0	25.6
	-	13.7	61.5	369.2

As compared to Alternative 4, Alternative 5 provides greater quantity of fish mix placed between Stations 3+20 and 3+80, hence creating a more protective layer in the area with the most scouring present. Once the fish mix erodes, it will lose its protective function and the filter rock portion in the beach may then continue to erode. As noted by Horn and Walton (2007), gravel-size material cannot armor a beach against wave and wake attack.

3.3 Recommendations

In reviewing the project objectives of providing an interim repair action that temporarily minimizes further erosion of the fill material into Sinclair Inlet and provides a functionally performing fish mix beach during development of the long term repair action with the above five alternatives, Alternative 4 best meets the objectives for the repair of the beach in the short term. Alternative 4 provides shoreline erosion protection and habitat improvement for fish spawning.

As a result of the Navy's budgetary constraints and the fact that the Stakeholders are in the process of developing a long term solution to control the erosion and protect the marine habitat at Charleston Beach in accordance with the OU A ROD, only Alternatives 3 (modified to not include the armor rock revetment), 4, and 5 were considered for the interim repair action. As such, these three alternatives were further examined by comparing their habitat functionality in the short term and long term, and by evaluating their protectiveness of the bluff and upland areas. All three alternatives provide habitat for fish spawning in the short term. However, only Alternatives 4 and 5 also provide shoreline erosion protection of the bluff. They also both perform similarly under the coastal processes of wind wave attack and tidal fluctuations. With Alternative 3 modified, the bluff would be exposed to erosive forces at a faster rate than the other alternatives. All three alternatives would be subjected to drifting of the fish mix material in the longshore and crosshore at the same rates.

Alternative 4 provides a more permanent erosion protection system along an approximate 50 foot stretch of the bluff as compared to Alternative 5. However, the protection provided by Alternative 4 is expected to advance erosion in the northeasterly direction as a result of the hardening of the upper portion of the beach. As compared to Alternative 4, Alternative 5 provides temporary protection to the eroded bluff, but is not expected to create additional erosion to the adjacent stretch of beach once the fish mix and gravel material are displaced by natural processes.

Alternative 5 is designed to provide slightly more coverage in the areas that have experienced the most erosion. The thickness of the fish mix layer in the most critical areas is up to 5 inches thicker than that provided in Alternative 4 for the same stretch of beach. More material was designed to be placed between Stations 3+20 and 3+80 because this area is an erosional hot spot and also, to a smaller extent, to counterbalance the lack of hard structure protection in this area. Thus, Alternative 5 provides better short term habitat enhancement due to larger fish mix coverage as compared to Alternative 4. However, with Alternative 5, there is potential that the angular filter rock placed along the toe of the bluff may mix with the fish mix over time and adversely impact the fish spawning habitat. Angular filter rock is not suitable for habitat development.

Although this document was prepared to support the short term solutions for Charleston Beach, a few recommendations are proposed to conclude the fish mix design study of Charleston Beach.

- Perform annual monitoring of the condition of the beach, including an estimation of erosion rates as monitoring and documenting the site conditions will provide insight on how the coastal processes are shaping this part of Sinclair Inlet. This could be readily accomplished through the conduct of annual profile measurements that may be compared to the post-interim-action profile.

- Evaluate the impact of wind-induced and more important, the influence of ship-generated waves and its effects on shoreline erosion along Charleston Beach. In many instances, the collection of field measurements is necessary to assess existing conditions and to provide essential calibration and validation of data for further scenario analysis.

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FISH MIX DESIGN DRAWINGS

BREMERTON NAVAL COMPLEX
BREMERTON, WASHINGTON
TASK ORDER NO. 31
FISH MIX DESIGN DRAWINGS

DRAWING NUMBER	TITLE	TOTAL SHEETS	REVISION
0031-CS-01	TITLE SHEET AND DRAWING LIST	1	A
0031-GP-ALT1	OUA CHARLESTON BEACH ALTERNATIVES 1, 2, AND 3 FISH MIX DESIGN PLAN	1	A
0031-XS-ALT1	OUA CHARLESTON BEACH ALTERNATIVE 1 FISH MIX DESIGN CROSS SECTIONS	4	A
0031-XS ALT2	OUA CHARLESTON BEACH ALTERNATIVE 2 FISH MIX DESIGN CROSS SECTIONS	3	A
0031-XS-ALT3	OUA CHARLESTON BEACH ALTERNATIVE 3 FISH MIX DESIGN CROSS SECTIONS	3	A
0031-GP-ALT4	OUA CHARLESTON BEACH ALTERNATIVE 4 FISH MIX DESIGN PLAN	1	A
0031-XS-ALT4	OUA CHARLESTON BEACH ALTERNATIVE 4 FISH MIX DESIGN CROSS SECTIONS	3	A
0031-GP-ALT5	OUA CHARLESTON BEACH ALTERNATIVE 5 FISH MIX DESIGN PLAN	1	A
0031-XS-ALT5	OUA CHARLESTON BEACH ALTERNATIVE 5 FISH MIX DESIGN CROSS SECTIONS	3	A

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BREMERTON, WASHINGTON

OUA CHARLESTON BEACH
TITLE SHEET AND DRAWING LIST

SES-TECH

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DRAWN: WDB		SM	
CHECKED: SO			
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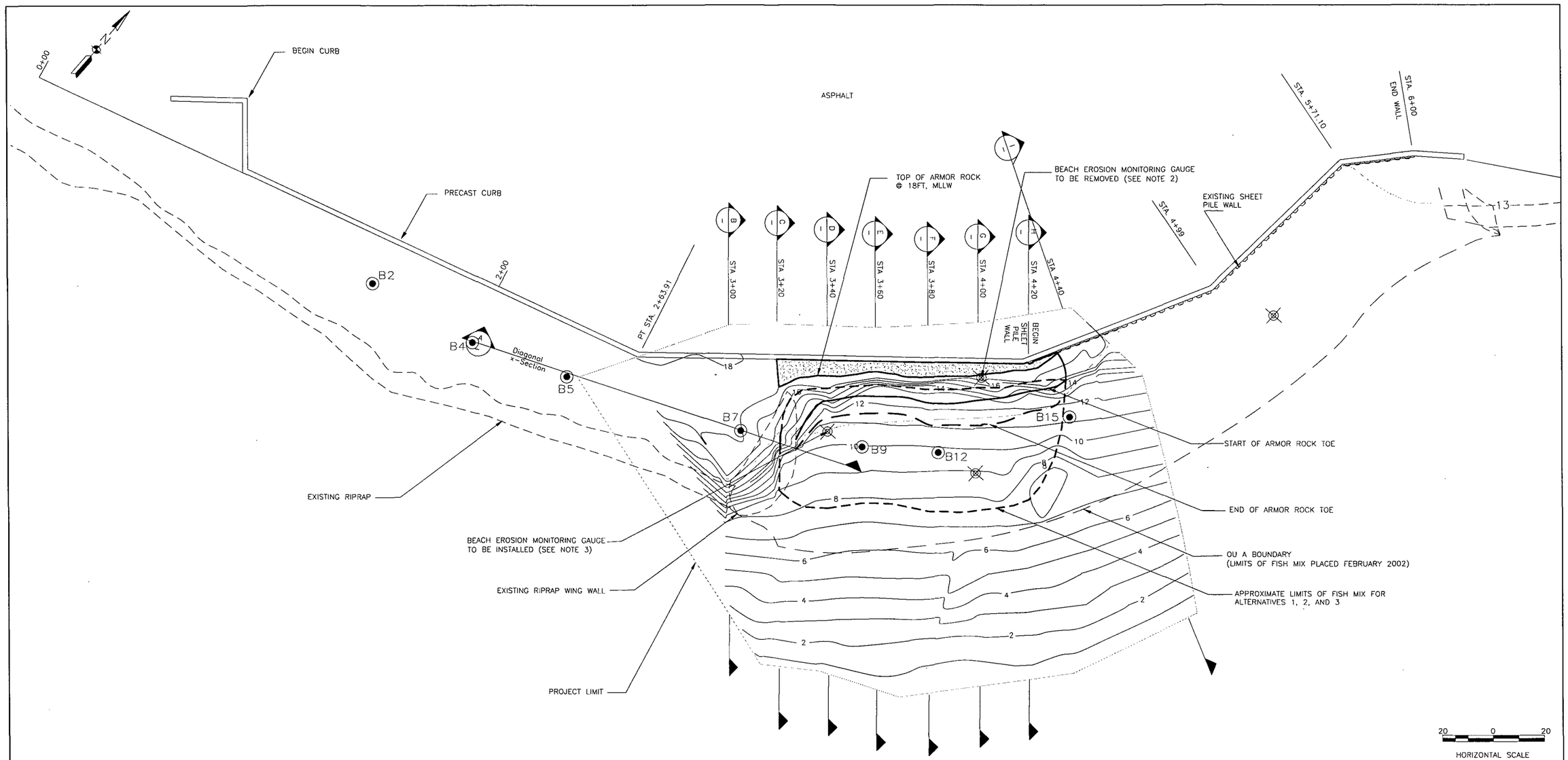

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LEGEND:

- BEACH EROSION MONITORING GAUGE
- SECTION A, 0,0 — CROSS SECTION LOCATION
- CONTOUR LINES AS OF SEPTEMBER 2007
- EXISTING RIPRAP
- TOPSOIL
- B2 — EXCAVATED SOIL AND EXPOSED FILL STATION LOCATIONS

NOTES:

1. TOPOGRAPHIC SURVEY CONDUCTED BY SES-TECH ON SEPTEMBER 10, 2007.
2. BEACH EROSION MONITORING GAUGE SHOWN AT TOP OF ARMOR ROCK WALL AND ANOTHER GAUGE ADJACENT TO THE EXISTING WING WALL (NOT SHOWN ON DRAWING) WILL BE REMOVED BY CUTTING FLUSH WITH GROUND SURFACE.
3. BEACH EROSION MONITORING GAUGE TO BE INSTALLED FABRICATED FROM 4" PVC PIPE, 6'-0" LONG. SET TOP FLUSH WITH FINISHED GRADE, CONCRETE FILLED.

BREMERTON TIDE DATA	
TIDE DATUM	ELEVATION (FT)
EXTREME HIGH WATER (EHW)	14.67*
MEAN HIGHER HIGH WATER (MHHW)	11.74**
MEAN LOWER LOW WATER (MLLW)	0**
*TIDAL DATA OBTAINED FROM U.S. ARMY CORPS OF ENGINEERS OFFICE AND NAUTICAL SOFTWARE.	
** NOAA STATION ID 9445958, TIDAL EPOCH: 1983-2001	

BASELINE COORDINATES AND BEARINGS	
STATION 0+00	N 206386.79 E 1188674.86
STATION 0+00 TO STATION 2+63.91	N 74°01'52"E
STATION 2+63.91 TO STATION 4+20	N 50°00'26"E

VERTICAL DATUM: MLLW = 0.0 FEET
HORIZONTAL DATUM: NAD83/91
STATION ID: 9445958, BREMERTON, WA
TIDAL EPOCH: 1983-2001

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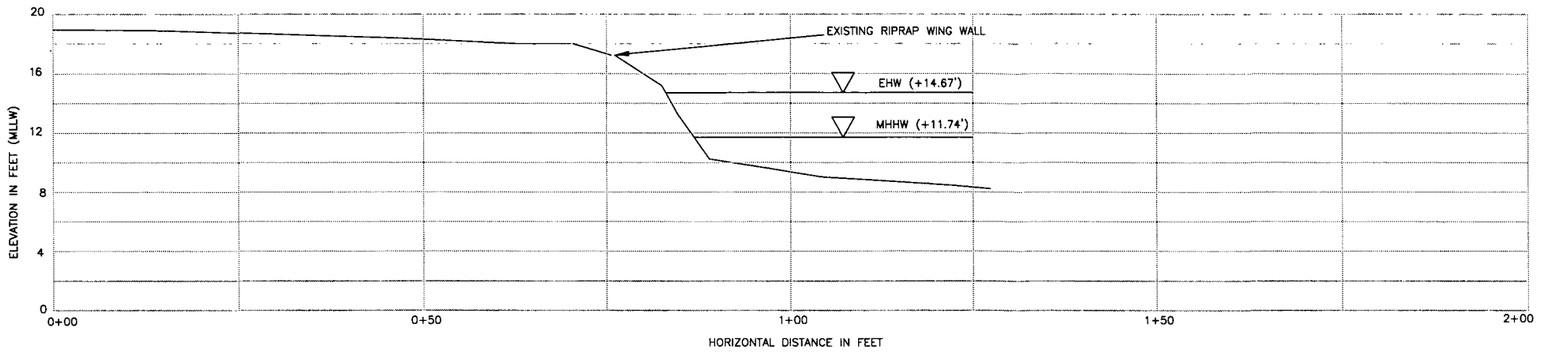
OUA CHARLESTON BEACH ALTERNATIVES 1, 2, AND 3 FISH MIX DESIGN PLAN

SES-TECH

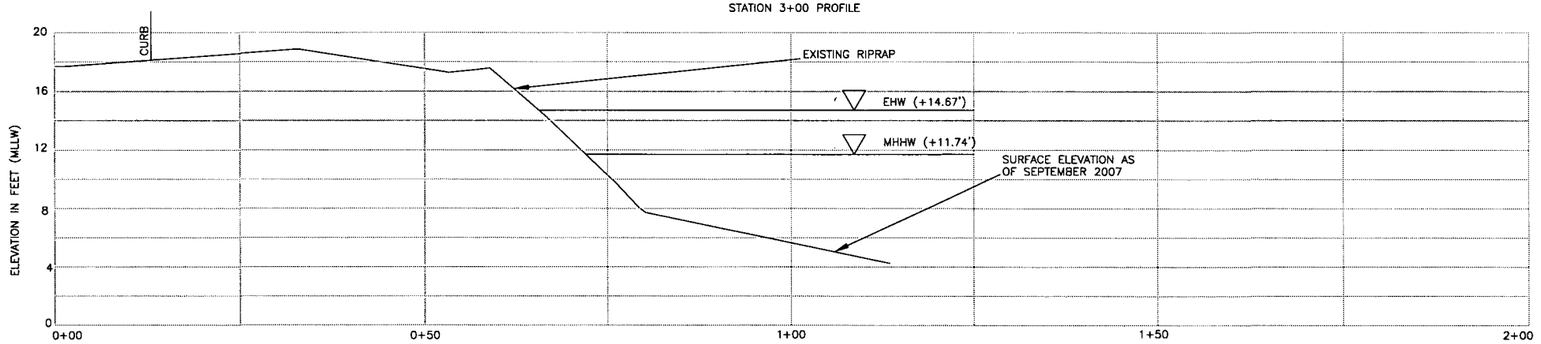
DESIGNED: ELR		APPROVED	
DRAWN: WDB		SM	
CHECKED: SO			
SIZE: D	SCALE: AS NOTED	DRAWING NO. 0031-GP-ALT1	1/1

DIAGONAL X_SEC PROFILE



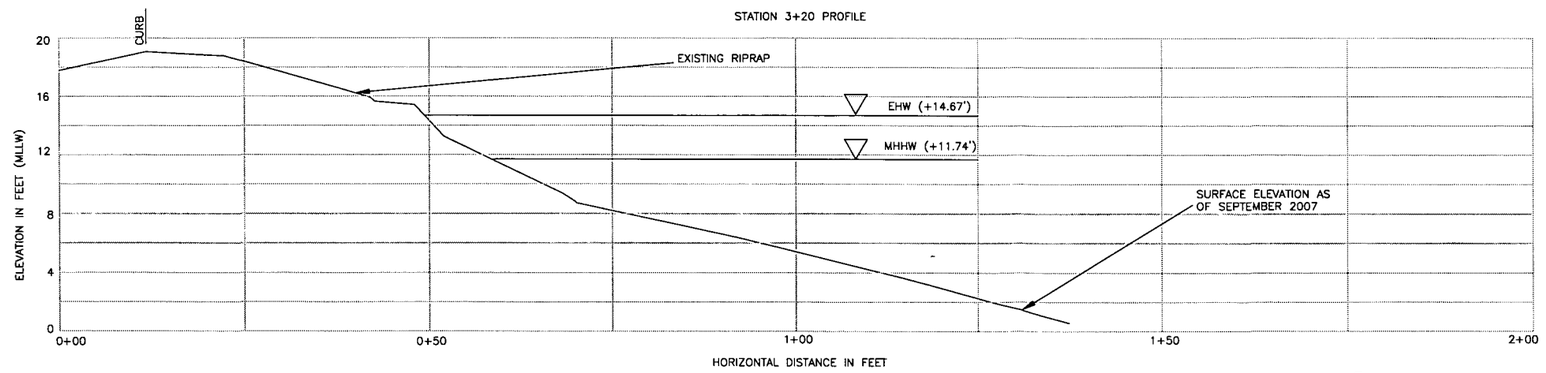
SECTION A/3

STATION 3+00 PROFILE



SECTION B/3

STATION 3+20 PROFILE



SECTION C/3

NOTE:
SECTIONS A, B, AND C FOR ALTERNATIVE 1 ARE ALSO APPLICABLE TO ALTERNATIVES 2, 3, 4, AND 5.

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VERTICAL SCALE

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STATION ID: 9445958, BREMERTON, WA
TIDAL EPOCH: 1983-2001

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OUA CHARLESTON BEACH ALTERNATIVE 1
FISH MIX DESIGN CROSS SECTIONS

SES-TECH

DESIGNED: ELR		APPROVED	
DRAWN: WDB		SM	
CHECKED: SO			
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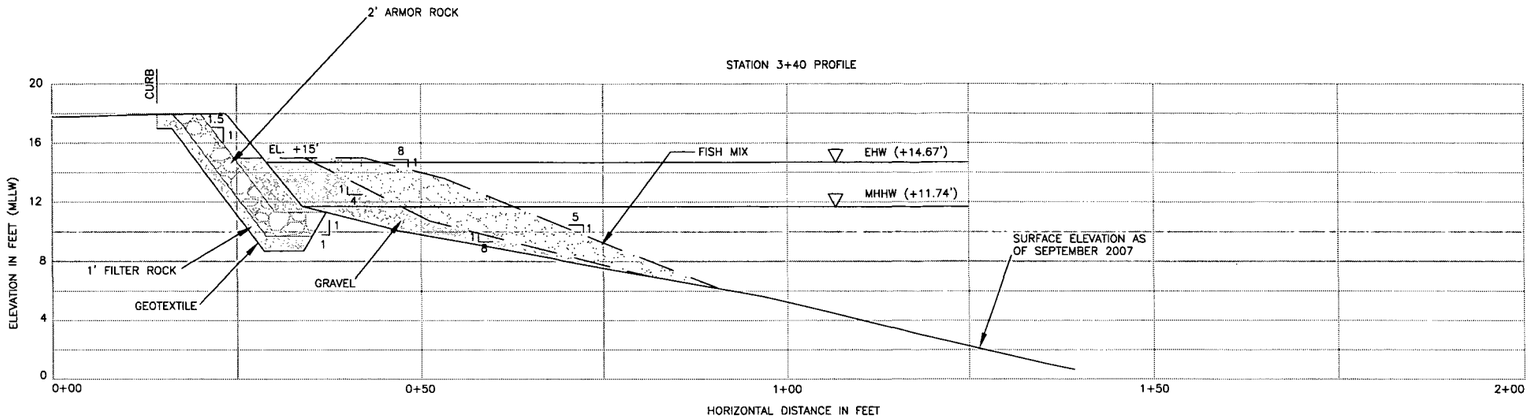
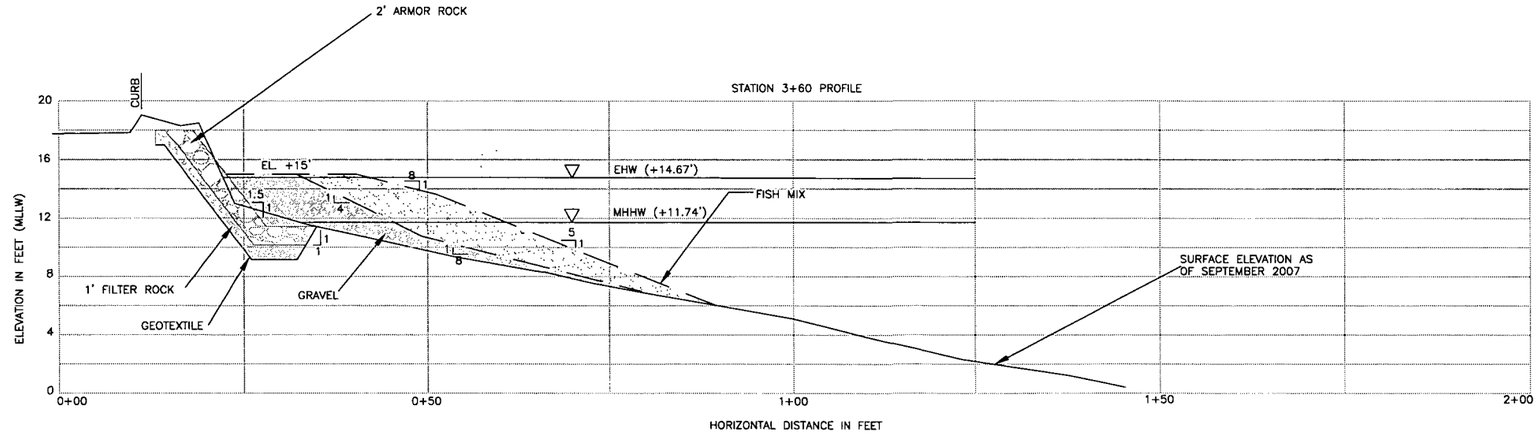


SECTION D/3



SECTION E/3

NOTE:
IN ALTERNATIVES 1 AND 2 GRAVEL BASE UNDER FISH MIX IS DESIGNED FOR A COMPOSITE BEACH AND SPECIFIED AS ROUND SPAWNING GRAVEL WITH SIMILAR GRADATION AS FILTER ROCK.

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VERTICAL SCALE

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TIDAL EPOCH: 1983-2001

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OUA CHARLESTON BEACH ALTERNATIVE 1
FISH MIX DESIGN CROSS SECTIONS

SES-TECH

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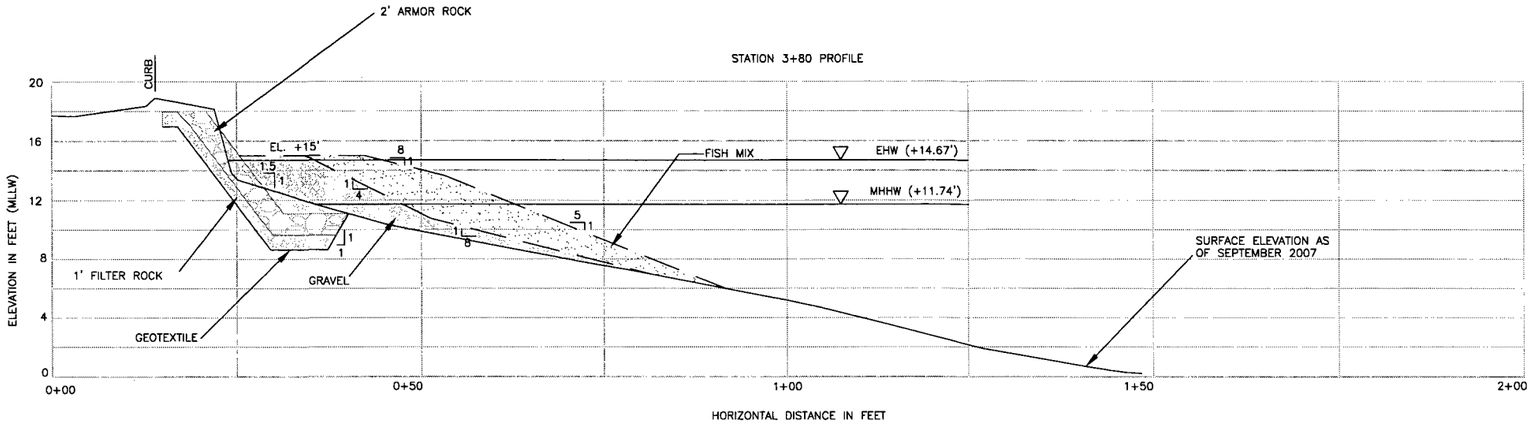

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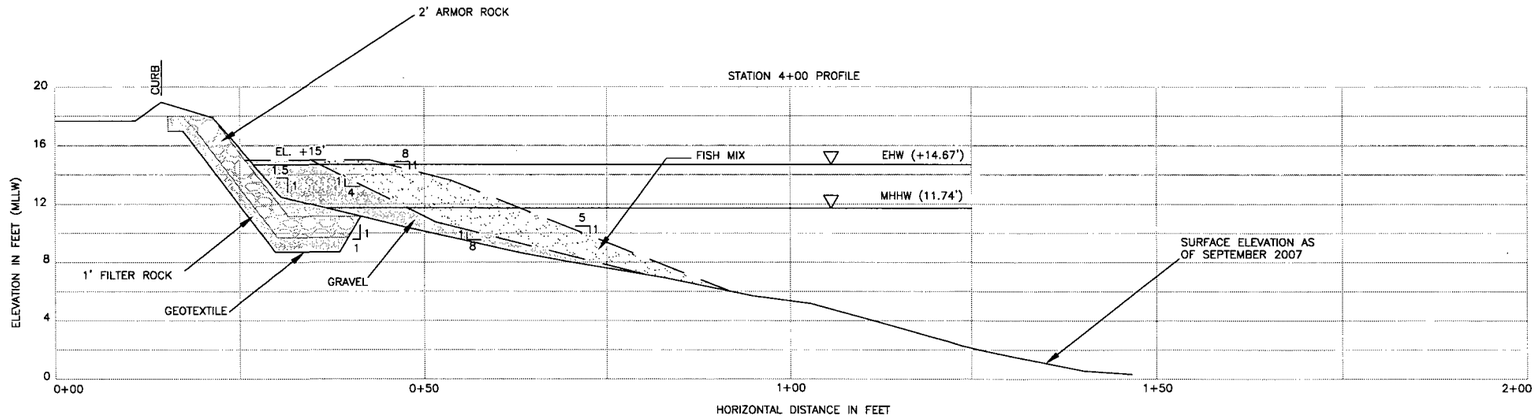

SECTION G 3

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TIDAL EPOCH: 1983-2001

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OUA CHARLESTON BEACH ALTERNATIVE 1
FISH MIX DESIGN CROSS SECTIONS

SES-TECH

DESIGNED: ELR		APPROVED	
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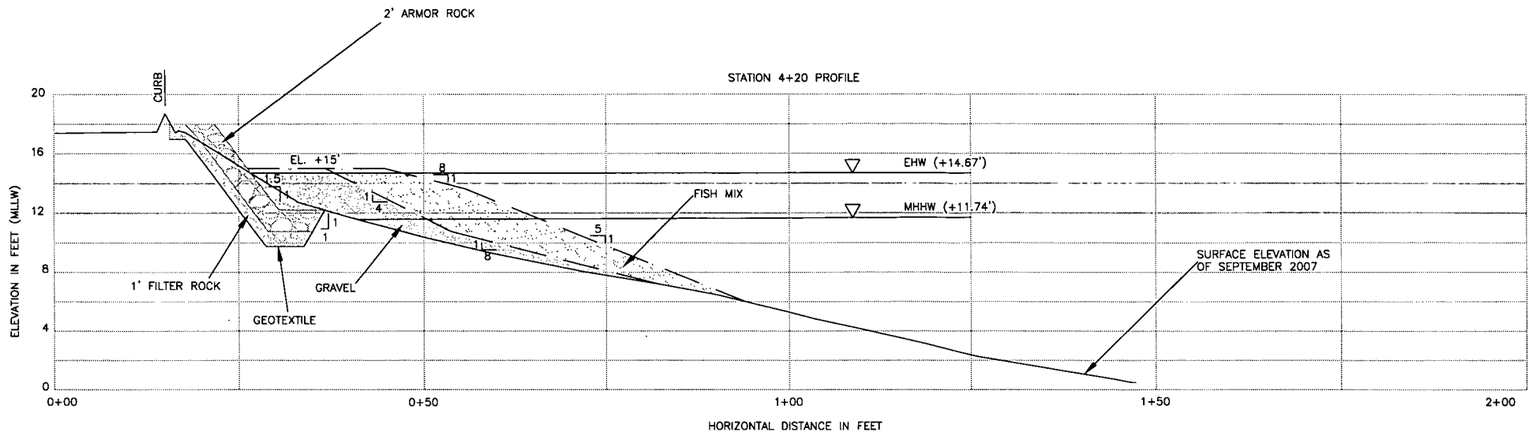
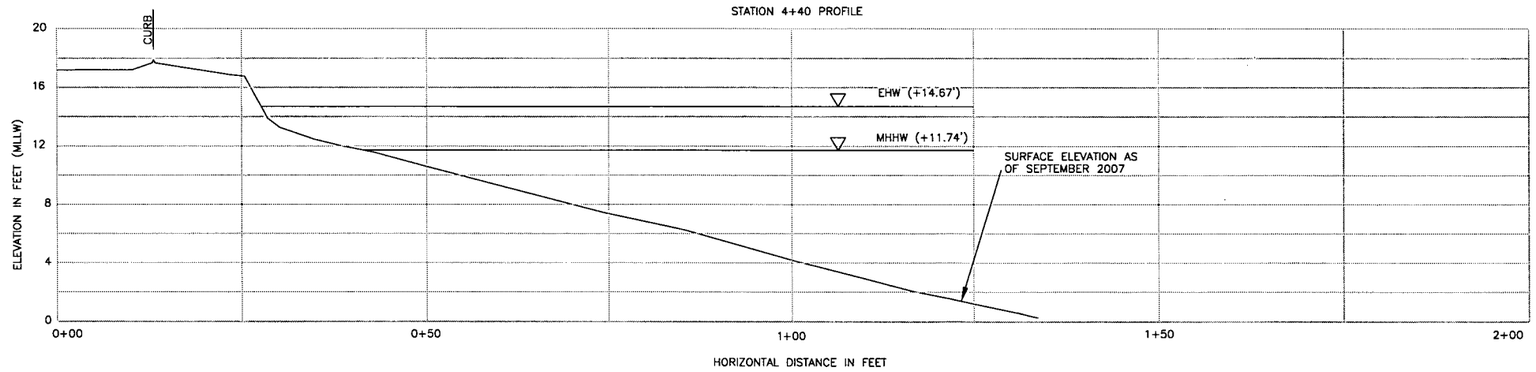


SECTION H/3



SECTION 1/3

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TIDAL EPOCH: 1983-2001

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OUA CHARLESTON BEACH ALTERNATIVE 1
FISH MIX DESIGN CROSS SECTIONS

SES-TECH

DESIGNED: ELR		APPROVED	
DRAWN: WDB		SM	
CHECKED: SO			
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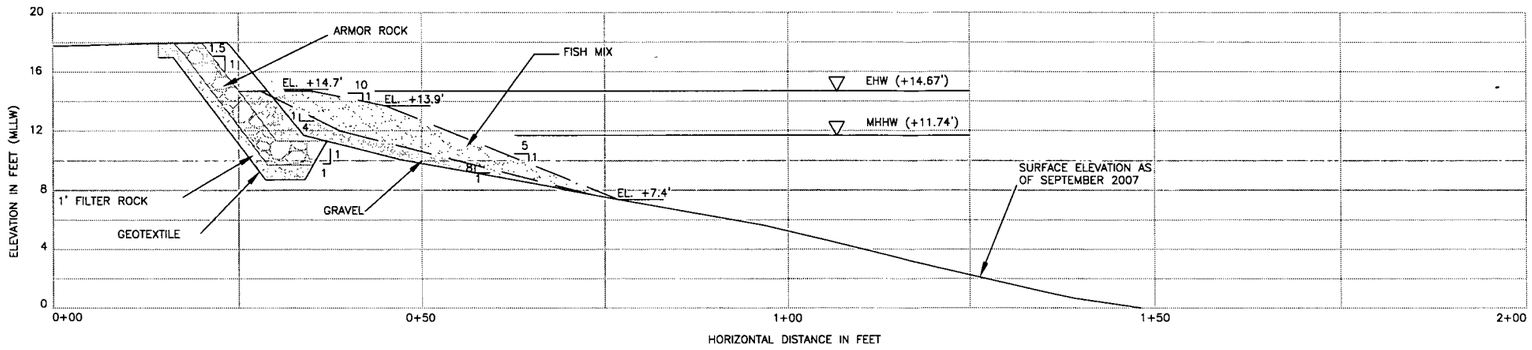
STATION 3+40 PROFILE



SECTION D/3

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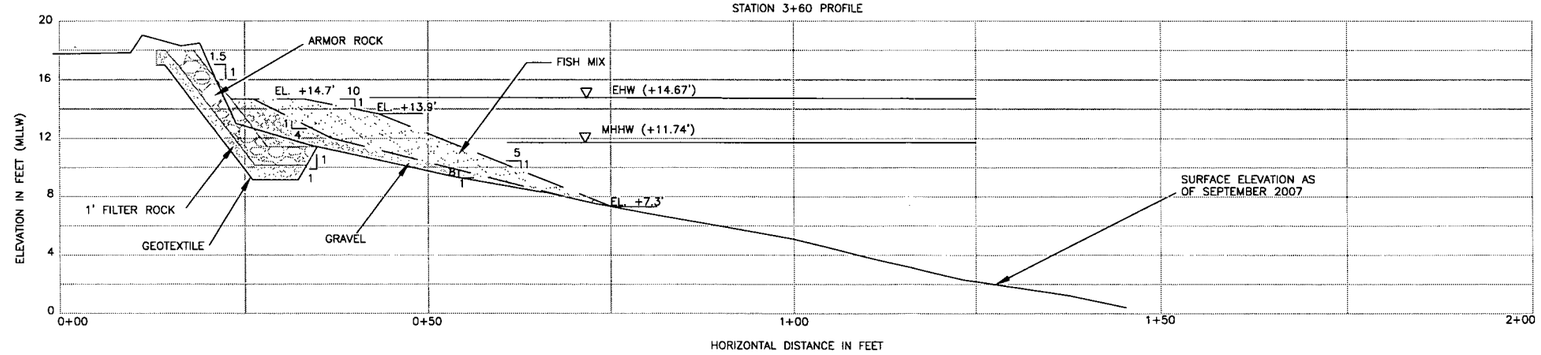

SECTION E/3

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STATION ID: 9445958, BREMERTON, WA
TIDAL EPOCH: 1983-2001

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NOT FOR CONSTRUCTION

DRAWING REDUCED HALFSIZE

P:\2973 CHARLESTON BEACH\CAD\APPENDIX F DRAWINGS\0031-XS-ALT2.DWG
PLOT/UPDATE: MAY 16 2008 08:49:07

DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND NORTHWEST
SILVERDALE, WASHINGTON

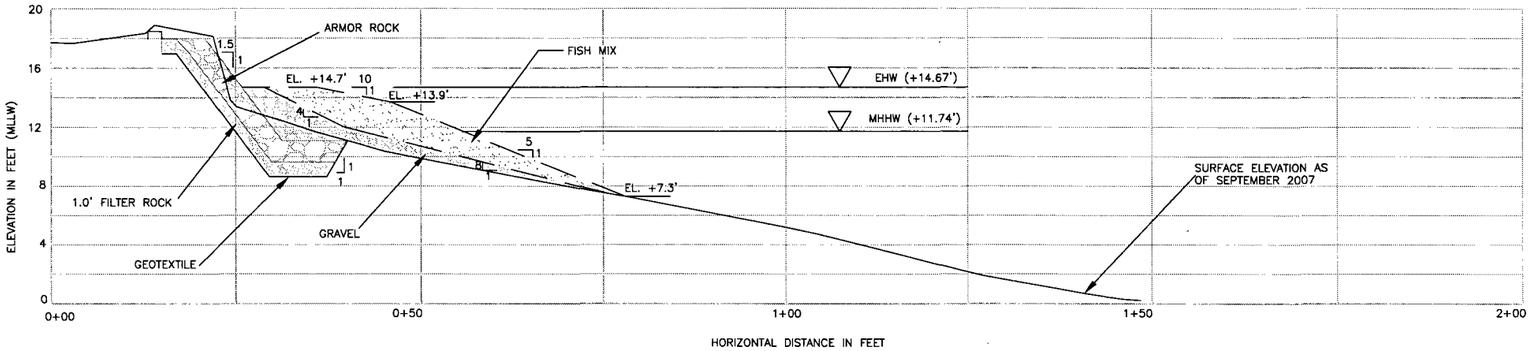
BREMERTON NAVAL COMPLEX
BREMERTON, WASHINGTON

OUA CHARLESTON BEACH ALTERNATIVE 2
FISH MIX DESIGN CROSS SECTIONS

SES-TECH

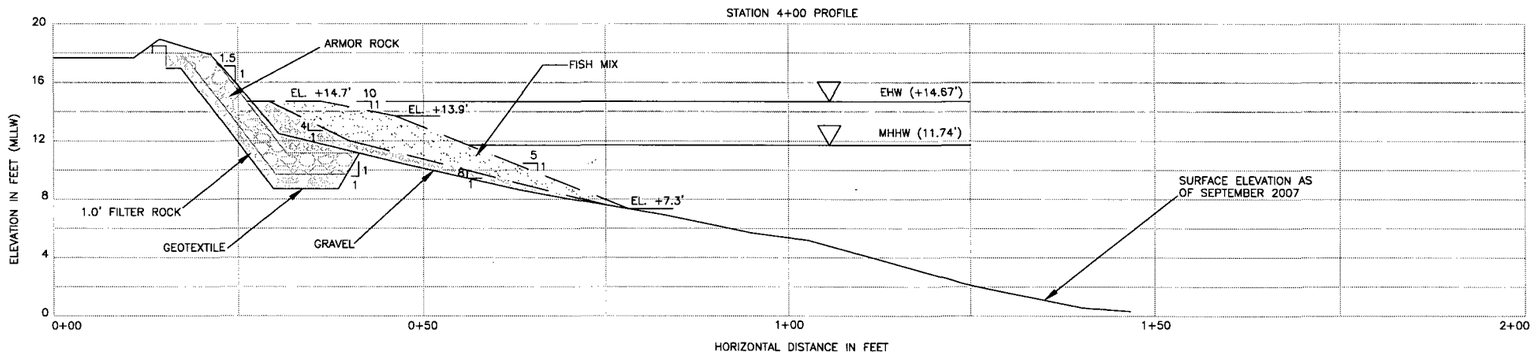
DESIGNED: ELR		APPROVED	
DRAWN: WDB		SM	
CHECKED: SO			
SIZE: D	SCALE: AS NOTED	DRAWING NO. 0031-XS-ALT2	1/3

STATION 3+80 PROFILE



SECTION F/3

STATION 4+00 PROFILE



SECTION G/3

5 0 5 10 20
HORIZONTAL SCALE

2.5 0 2.5 5 10
VERTICAL SCALE

VERTICAL DATUM: MLLW = 0.0 FEET
HORIZONTAL DATUM: NAD83/91
STATION ID: 9445958, BREMERTON, WA
TIDAL EPOCH: 1983-2001

DRAFT
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DRAWING REDUCED HALFSIZE

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PLOT/UPDATE: MAY 16 2008 08:50:21

DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND NORTHWEST
SILVERDALE, WASHINGTON

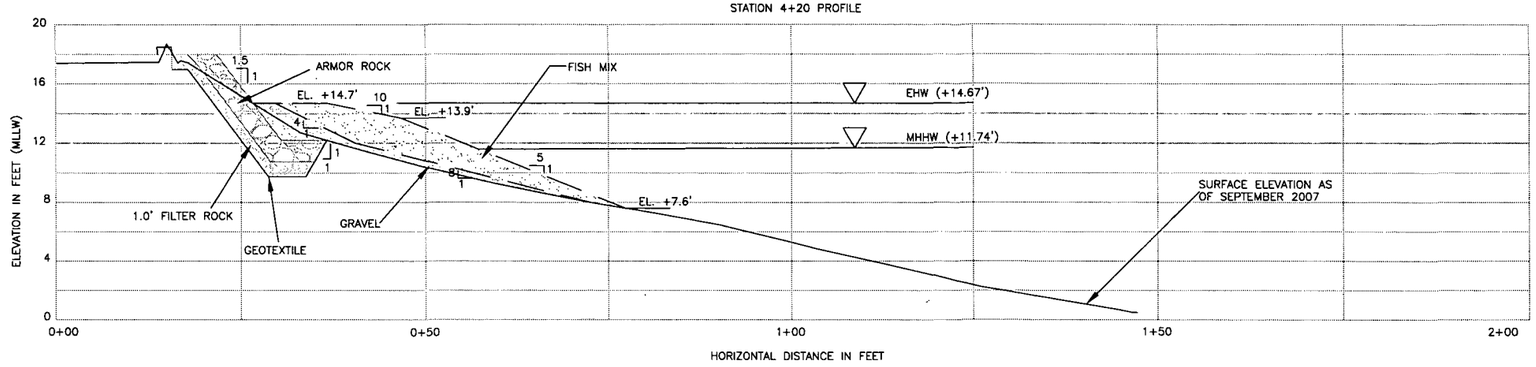
BREMERTON NAVAL COMPLEX
BREMERTON, WASHINGTON

OUA CHARLESTON BEACH ALTERNATIVE 2
FISH MIX DESIGN CROSS SECTIONS

SES-TECH

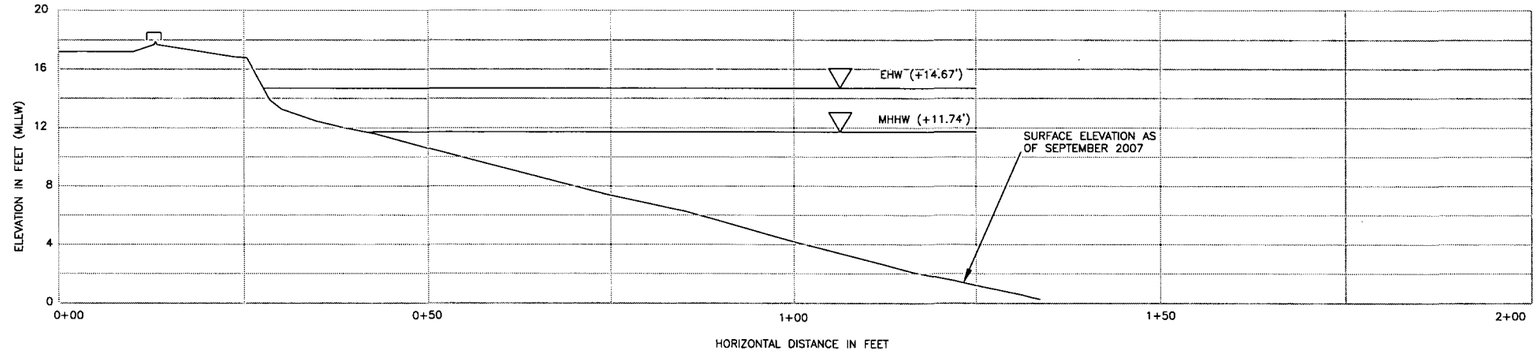
DESIGNED: ELR		APPROVED	
DRAWN: WDB		SM	
CHECKED: SO			
SIZE: D	SCALE: AS NOTED	DRAWING NO. 0031-XS-ALT2	2/3

STATION 4+20 PROFILE



SECTION H/3

STATION 4+40 PROFILE



SECTION 1/3

5 0 5 10 20
HORIZONTAL SCALE

2.5 0 2.5 5 10
VERTICAL SCALE

VERTICAL DATUM: MLLW = 0.0 FEET
HORIZONTAL DATUM: NAD83/91
STATION ID: 9445958, BREMERTON, WA
TIDAL EPOCH: 1983-2001

DRAFT
NOT FOR CONSTRUCTION

DRAWING REDUCED
HALFSIZE

DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND NORTHWEST
SILVERDALE, WASHINGTON

BREMERTON NAVAL COMPLEX
BREMERTON, WASHINGTON

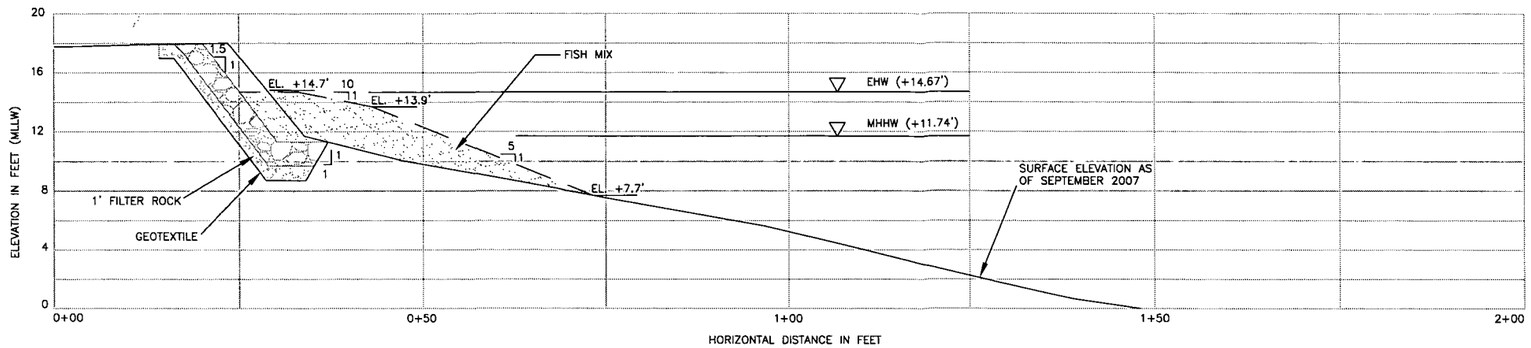
OUA CHARLESTON BEACH ALTERNATIVE 2
FISH MIX DESIGN CROSS SECTIONS

SES-TECH

DESIGNED: ELR		APPROVED	
DRAWN: WDB		SM	
CHECKED: SO			
SIZE: D	SCALE: AS NOTED	DRAWING NO. 0031-XS-ALT2	3/3

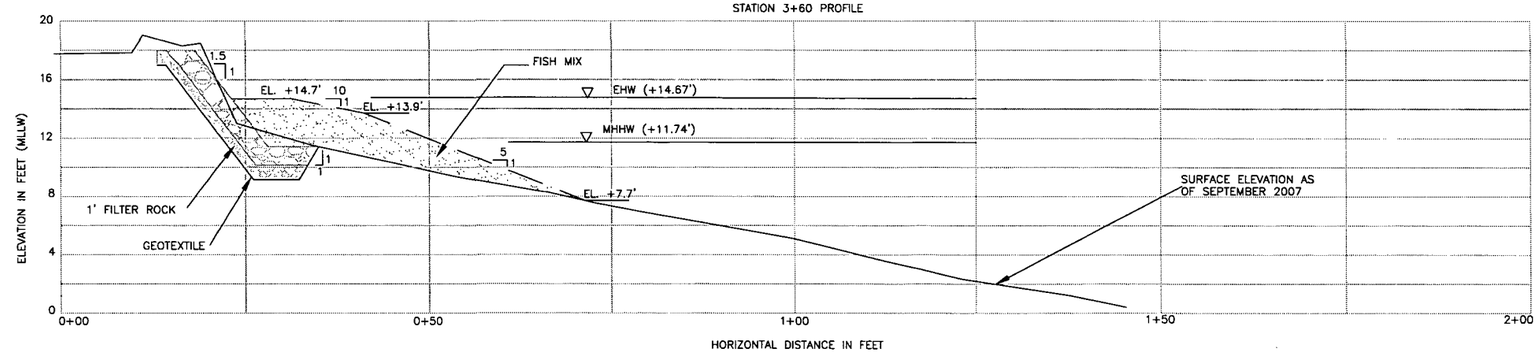
P:\2973 CHARLESTON BEACH\CAD\APPENDIX F DRAWINGS\0031-XS-ALT2.DWG
PLOT/UPDATE: MAY 16 2008 08:51:55

STATION 3+40 PROFILE



SECTION D/3

STATION 3+60 PROFILE



SECTION E/3

5 0 5 10 20
HORIZONTAL SCALE

2.5 0 2.5 5 10
VERTICAL SCALE

VERTICAL DATUM: MLLW = 0.0 FEET
HORIZONTAL DATUM: NAD83/91
STATION ID: 9445958, BREMERTON, WA
TIDAL EPOCH: 1983-2001

DRAFT
NOT FOR CONSTRUCTION

DRAWING REDUCED HALFSIZE

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PLOT/UPDATE: MAY 16 2008 08:53:06

DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND NORTHWEST
SILVERDALE, WASHINGTON

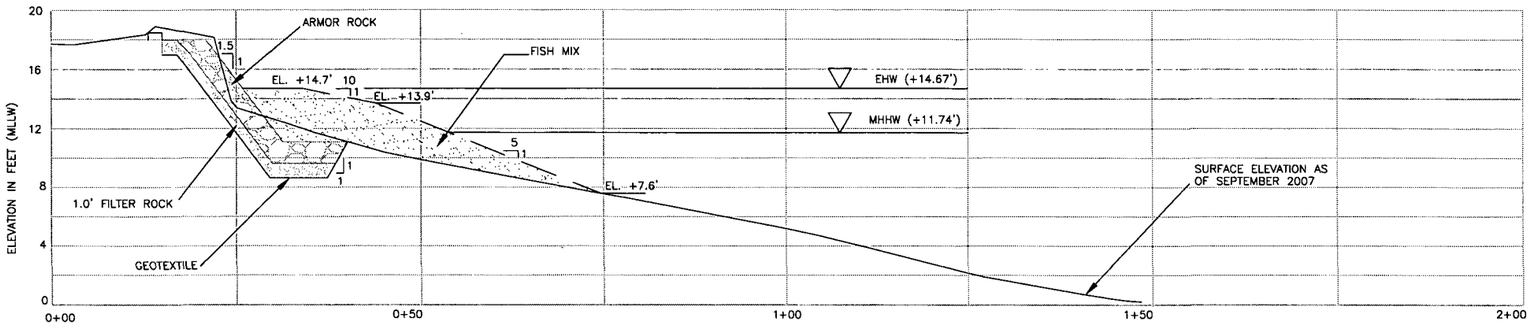
BREMERTON NAVAL COMPLEX
BREMERTON, WASHINGTON

OUA CHARLESTON BEACH ALTERNATIVE 3
FISH MIX DESIGN CROSS SECTIONS

SES-TECH

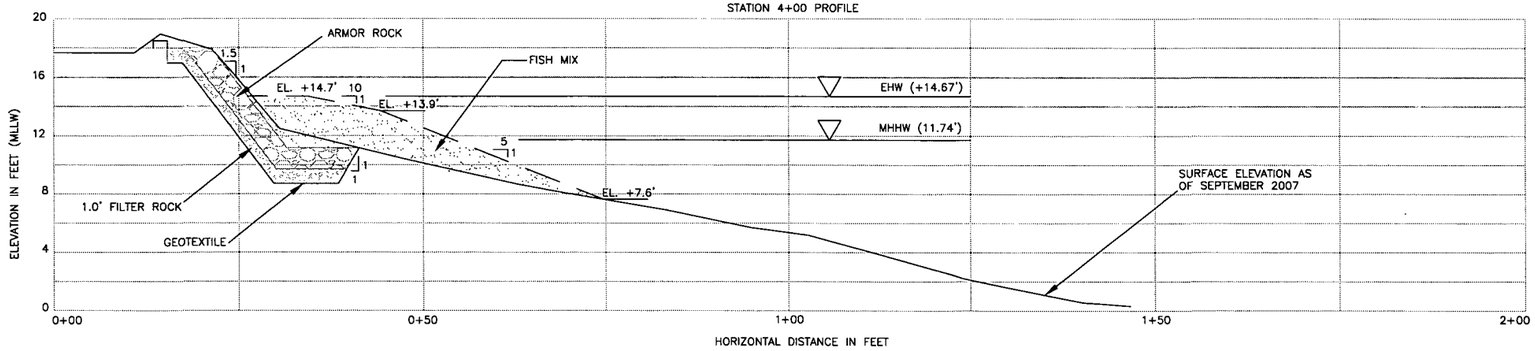
DESIGNED: ELR		APPROVED	
DRAWN: WDB		SM	
CHECKED: SO			
SIZE: D	SCALE: AS NOTED	DRAWING NO. 0031-XS-ALT3	1/3

STATION 3+80 PROFILE



SECTION F/3

STATION 4+00 PROFILE



SECTION G/3

5 0 5 10 20
HORIZONTAL SCALE

2.5 0 2.5 5 10
VERTICAL SCALE

VERTICAL DATUM: MLLW = 0.0 FEET
HORIZONTAL DATUM: NAD83/91
STATION ID: 9445958, BREMERTON, WA
TIDAL EPOCH: 1983-2001

DRAFT
NOT FOR CONSTRUCTION

DRAWING REDUCED HALFSIZE

P:\2973 CHARLESTON BEACH\CAD\APPENDIX F DRAWINGS\0031-XS-ALT3.DWG
PLOT/UPDATE: MAY 16 2008 08:53:54

DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND NORTHWEST
SILVERDALE, WASHINGTON

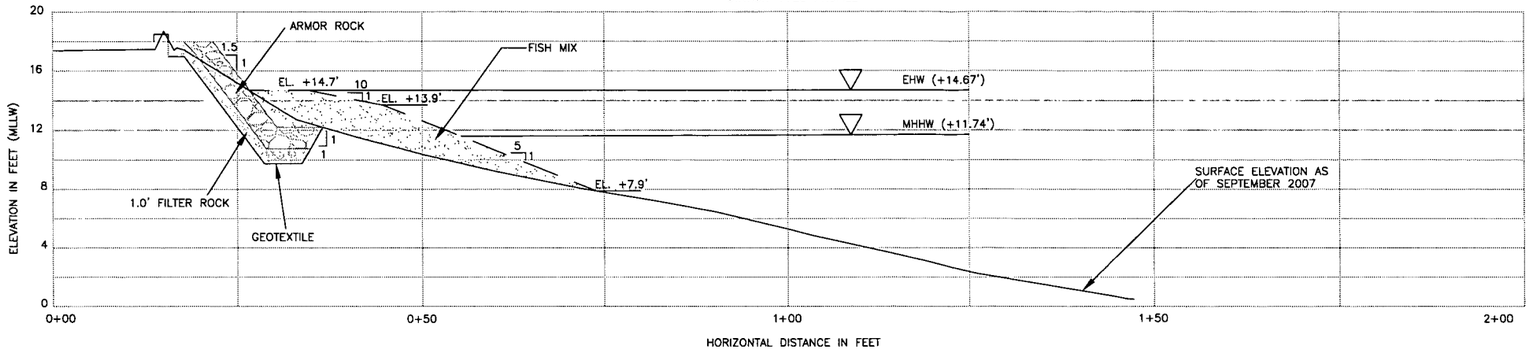
BREMERTON NAVAL COMPLEX
BREMERTON, WASHINGTON

OUA CHARLESTON BEACH ALTERNATIVE 3
FISH MIX DESIGN CROSS SECTIONS

SES-TECH

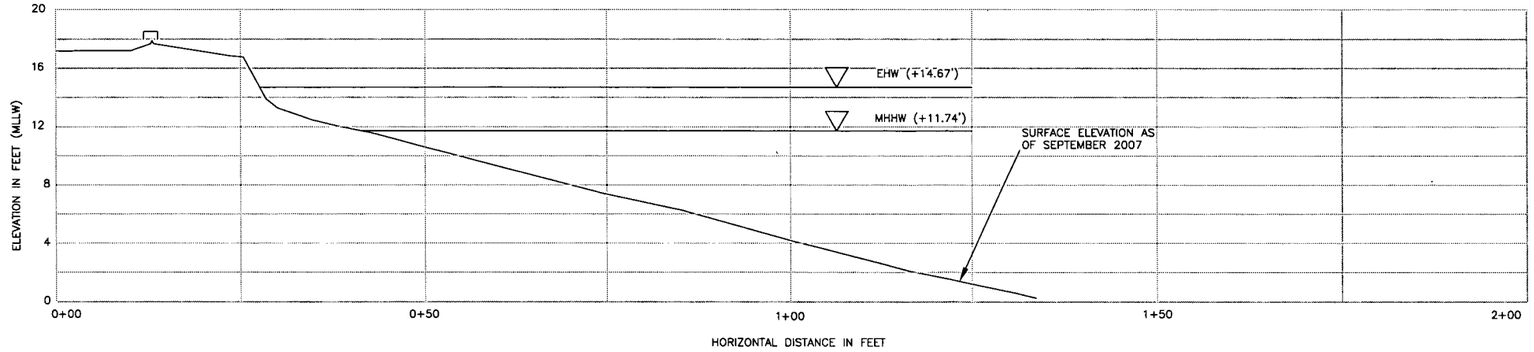
DESIGNED: ELR	APPROVED		
DRAWN: WDB	SM		
CHECKED: SO			
SIZE: D	SCALE: AS NOTED	DRAWING NO. 0031-XS-ALT3	2/3

STATION 4+20 PROFILE



SECTION H 3

STATION 4+40 PROFILE



SECTION 1 3

5 0 5 10 20
HORIZONTAL SCALE

2.5 0 2.5 5 10
VERTICAL SCALE

VERTICAL DATUM: MLLW = 0.0 FEET
HORIZONTAL DATUM: NAD83/91
STATION ID: 9445958, BREMERTON, WA
TIDAL EPOCH: 1983-2001

DRAFT
NOT FOR CONSTRUCTION

DRAWING REDUCED
HALFSIZE

DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND NORTHWEST
SILVERDALE, WASHINGTON

BREMERTON NAVAL COMPLEX
BREMERTON, WASHINGTON

OUA CHARLESTON BEACH ALTERNATIVE 3
FISH MIX DESIGN CROSS SECTIONS

SES-TECH

DESIGNED: ELR		APPROVED	
DRAWN: WDB		SM	
CHECKED: SO			
SIZE: D	SCALE: AS NOTED	DRAWING NO. 0031-XS-ALT3	3/3

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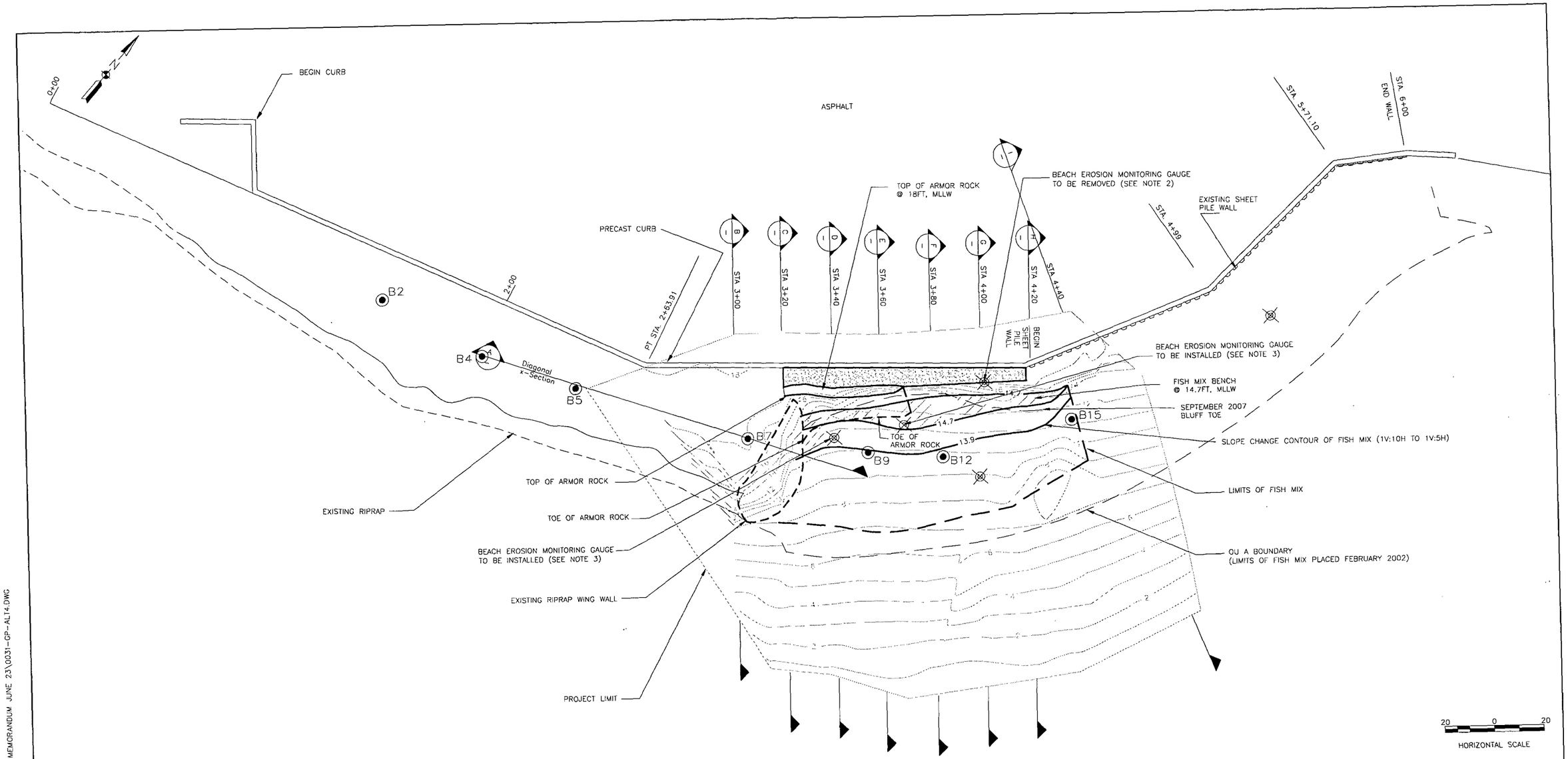

20 0 20

HORIZONTAL SCALE

LEGEND:

- BEACH EROSION MONITORING GAUGE
- SECTION A / A – 0,0 CROSS SECTION LOCATION
- CONTOUR LINES AS OF SEPTEMBER 2007
- EXISTING RIPRAP
- TOPSOIL
- B2 EXCAVATED SOIL AND EXPOSED FILL STATION LOCATIONS

NOTES:

1. TOPOGRAPHIC SURVEY CONDUCTED BY SES-TECH ON SEPTEMBER 10, 2007.
2. BEACH EROSION MONITORING GAUGE SHOWN IN TOPSOIL AND ANOTHER GAUGE ADJACENT TO THE EXISTING WING WALL (NOT SHOWN ON DRAWING) WILL BE REMOVED BY CUTTING FLUSH WITH GROUND SURFACE.
3. BEACH EROSION MONITORING GAUGE TO BE INSTALLED FABRICATED FROM 4" PVC PIPE, 6'-0" LONG, SET TOP FLUSH WITH FINISHED GRADE, CONCRETE FILLED. NEW GAUGE IS TO BE PLACED IN FRONT OF TOE OF ARMOR ROCK. PLACE APPROXIMATELY 3 FEET OF TOPSOIL OVER FILL MATERIAL. REDUCE THICKNESS AS REQUIRED TO MATCH TOP OF CURB AND TAPER TO MATCH TOP OF SLOPE.

BREMERTON TIDE DATA	
TIDE DATUM	ELEVATION (FT)
EXTREME HIGH WATER (EHW)	14.67*
MEAN HIGHER HIGH WATER (MHHW)	11.74**
MEAN LOWER LOW WATER (MLLW)	0**
*TIDAL DATA OBTAINED FROM U.S. ARMY CORPS OF ENGINEERS OFFICE AND NAUTICAL SOFTWARE.	
** NOAA STATION ID 9445958, TIDAL EPOCH: 1983-2001	

BASELINE COORDINATES AND BEARINGS	
STATION 0+00	N 206386.79 E 1188674.86
STATION 0+00 TO STATION 2+63.91	N 74°01'52"E
STATION 2+63.91 TO STATION 4+20	N 50°00'26"E

VERTICAL DATUM: MLLW = 0.0 FEET
HORIZONTAL DATUM: NAD83/91
STATION ID: 9445958, BREMERTON, WA
TIDAL EPOCH: 1983-2001

DRAFT
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DRAWING REDUCED HALFSIZE

DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND NORTHWEST
SILVERDALE, WASHINGTON

BREMERTON NAVAL COMPLEX
BREMERTON, WASHINGTON

OUA CHARLESTON BEACH ALTERNATIVE 4
FISH MIX DESIGN PLAN

SES-TECH

DESIGNED: ELR		APPROVED	
DRAWN: WDB		SM	
CHECKED: SO			
SIZE: D	SCALE: AS NOTED	DRAWING NO. 0031-GP-ALT4	1/1

P:\2973 CHARLESTON BEACH\CAD\APPENDIX F DRAWINGS\DESIGN MEMORANDUM JUNE 23\0031-GP-ALT4.DWG
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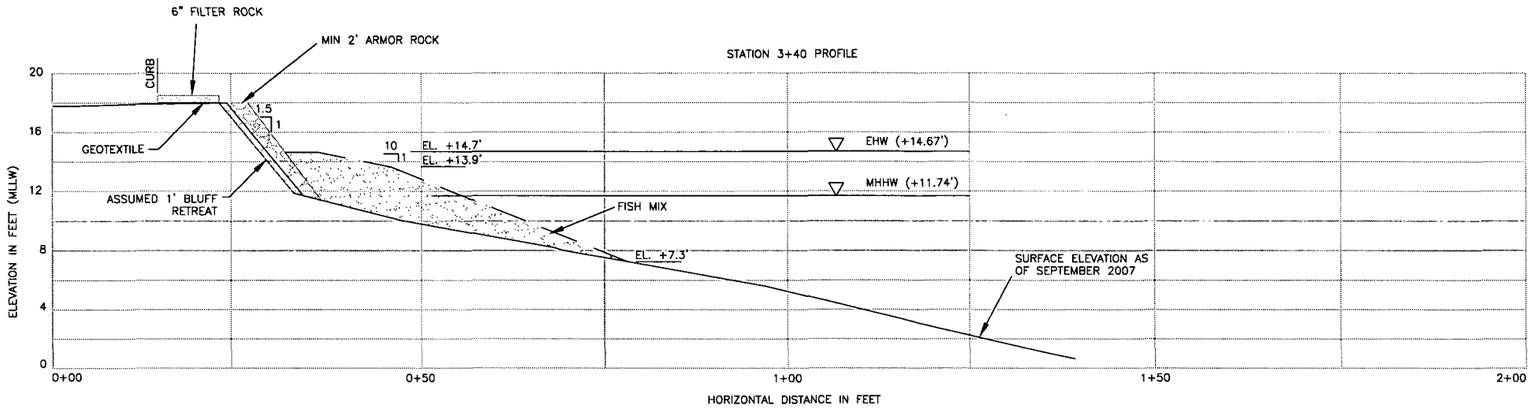
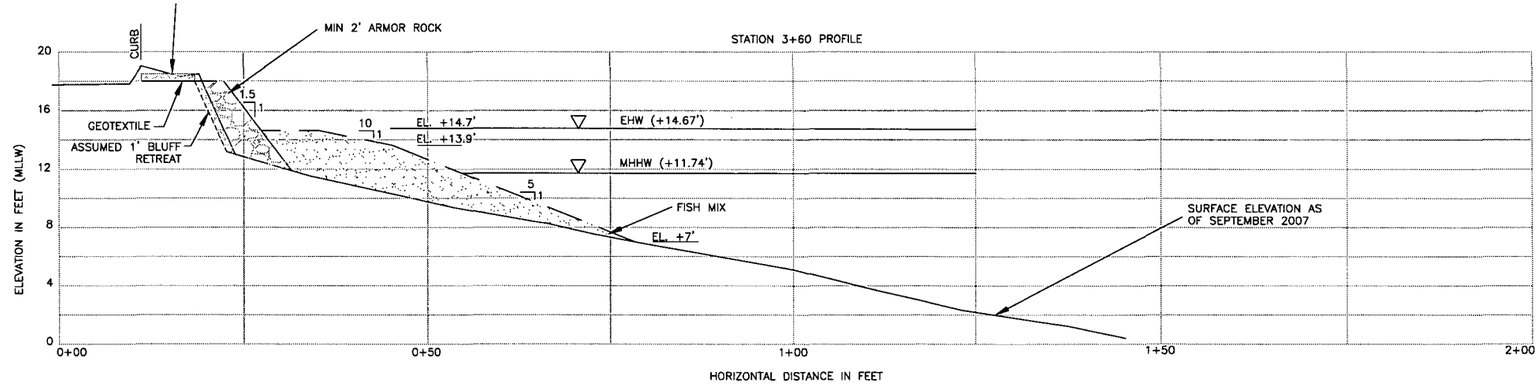


SECTION D/3



SECTION E/3

NOTE:
1. GEOTEXTILE WILL BE PLACED OVER EXPOSED TOPSOIL SURFACE AND SECURED WITH FILTER ROCK; NO VEGETATION WILL BE INSTALLED.
2. ACTUAL VOLUMES AND ELEVATIONS MAY DIFFER THAN INDICATED ON DRAWINGS BASED ON ACTUAL FIELD CONDITIONS. PLACEMENT VOLUME OF ARMOR ROCK AND FILTER ROCK WILL BE LIMITED TO THE VOLUME EXISTING ON SITE (157 TONS OF EACH).
3. EXISTING RIPRAP AND THE NEW ARMOR ROCK WILL BE TRANSITIONED BETWEEN STATION 3+20 AND 3+30. PLACE ONE LAYER OF ARMOR ROCK BETWEEN STATION 3+15 AND 3+20.
4. ARMOR ROCK WALL THICKNESS WILL BE REDUCED GRADUALLY STARTING AT STATION 3+60 AND TAPERED OFF WITH THE EXISTING GRADE BETWEEN STATION 3+60 AND 3+70.
5. ARMOR ROCK WILL BE PLACED ALONG SHORELINE AT A 1V:1.5H SLOPE. PLACEMENT THICKNESS MAY VARY BASED ON ACTUAL FIELD CONDITIONS. NO EXCAVATION WILL BE PERFORMED PRIOR TO PLACEMENT OF ARMOR ROCK.
6. HORIZONTAL EXTENT OF ARMOR ROCK WILL BE ADJUSTED BASED ON ACTUAL EROSION CONDITIONS.

5 0 5 10 20
HORIZONTAL SCALE

2.5 0 2.5 5 10
VERTICAL SCALE

VERTICAL DATUM: MLLW = 0.0 FEET
HORIZONTAL DATUM: NAD83/91
STATION ID: 9445958, BREMERTON, WA
TIDAL EPOCH: 1983-2001

DRAFT
NOT FOR CONSTRUCTION

DRAWING REDUCED HALFSIZE

DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND NORTHWEST
SILVERDALE, WASHINGTON

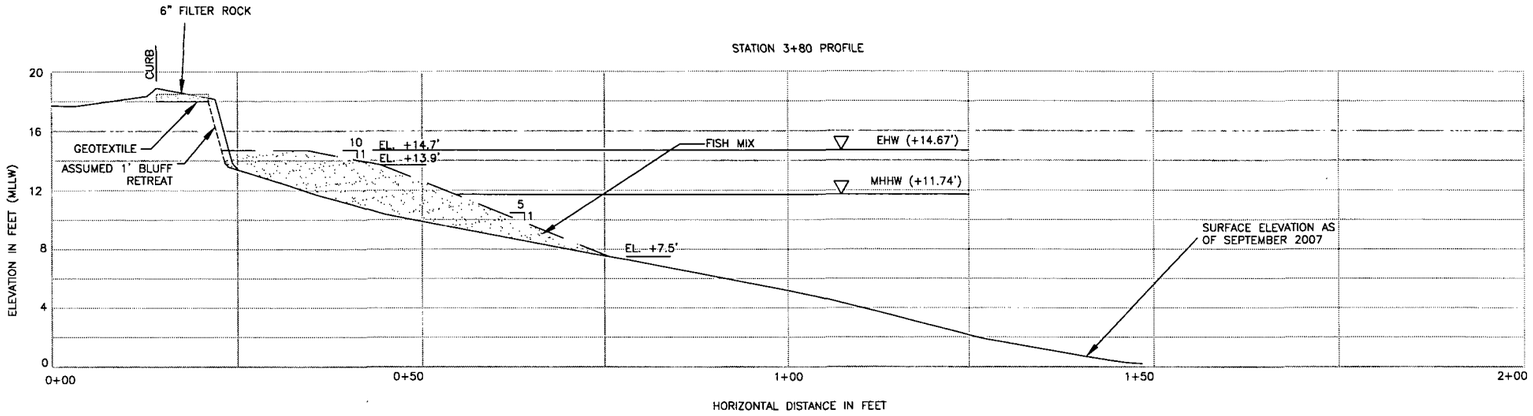
BREMERTON NAVAL COMPLEX
BREMERTON, WASHINGTON

OUA CHARLESTON BEACH ALTERNATIVE 4
FISH MIX DESIGN CROSS SECTIONS

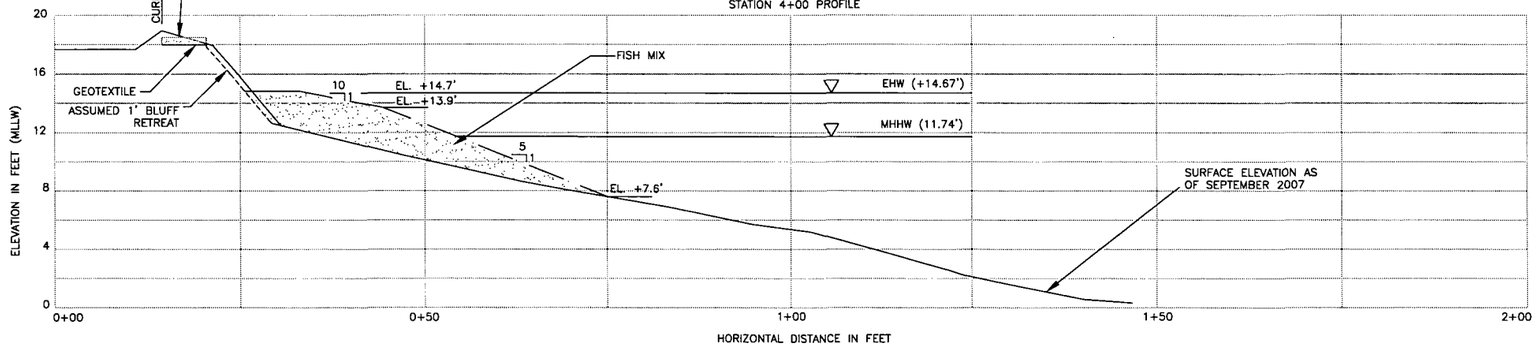
SES-TECH

DESIGNED: ELR		APPROVED	
DRAWN: WDB		SM	
CHECKED: SO			
SIZE: D	SCALE: AS NOTED	DRAWING NO. 0031-XS-ALT4	1/3

P:\2973 CHARLESTON BEACH\CAD\APPENDIX F DRAWINGS\DESIGN MEMORANDUM JUNE 23\0031-XS-ALT4.DWG
PLOT/UPDATE: JUN 23 2008 16:11:21



SECTION F/3



SECTION G/3

NOTE:
1. GEOTEXTILE WILL BE PLACED OVER EXPOSED TOPSOIL SURFACE AND SECURED WITH FILTER ROCK; NO VEGETATION WILL BE INSTALLED.
2. ACTUAL VOLUMES AND ELEVATIONS MAY DIFFER THAN INDICATED ON DRAWINGS BASED ON ACTUAL FIELD CONDITIONS. PLACEMENT VOLUME OF ARMOR ROCK AND FILTER ROCK WILL BE LIMITED TO THE VOLUME EXISTING ON SITE (157 TONS OF EACH).
3. EXISTING RIPRAP AND THE NEW ARMOR ROCK WILL BE TRANSITIONED BETWEEN STATION 3+20 AND 3+30. PLACE ONE LAYER OF ARMOR ROCK BETWEEN STATION 3+15 AND 3+20.
4. ARMOR ROCK WALL THICKNESS WILL BE REDUCED GRADUALLY STARTING AT STATION 3+60 AND TAPERED OFF WITH THE EXISTING GRADE BETWEEN STATION 3+60 AND 3+70.
5. ARMOR ROCK WILL BE PLACED ALONG SHORELINE AT A 1V:1.5H SLOPE. PLACEMENT THICKNESS MAY VARY BASED ON ACTUAL FIELD CONDITIONS. NO EXCAVATION WILL BE PERFORMED PRIOR TO PLACEMENT OF ARMOR ROCK.
6. HORIZONTAL EXTENT OF ARMOR ROCK WILL BE ADJUSTED BASED ON ACTUAL EROSION CONDITIONS.

5 0 5 10 20
HORIZONTAL SCALE
2.5 0 2.5 5 10
VERTICAL SCALE

VERTICAL DATUM: MLLW = 0.0 FEET
HORIZONTAL DATUM: NAD83/91
STATION ID: 9445958, BREMERTON, WA
TIDAL EPOCH: 1983-2001

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DRAWING REDUCED HALFSIZE

DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND NORTHWEST
SILVERDALE, WASHINGTON

BREMERTON NAVAL COMPLEX
BREMERTON, WASHINGTON

OUA CHARLESTON BEACH ALTERNATIVE 4
FISH MIX DESIGN CROSS SECTIONS

SES-TECH

DESIGNED: ELR		APPROVED	
DRAWN: WDB		SM	
CHECKED: SO			
SIZE: D	SCALE: AS NOTED	DRAWING NO. 0031-XS-ALT4	2/3

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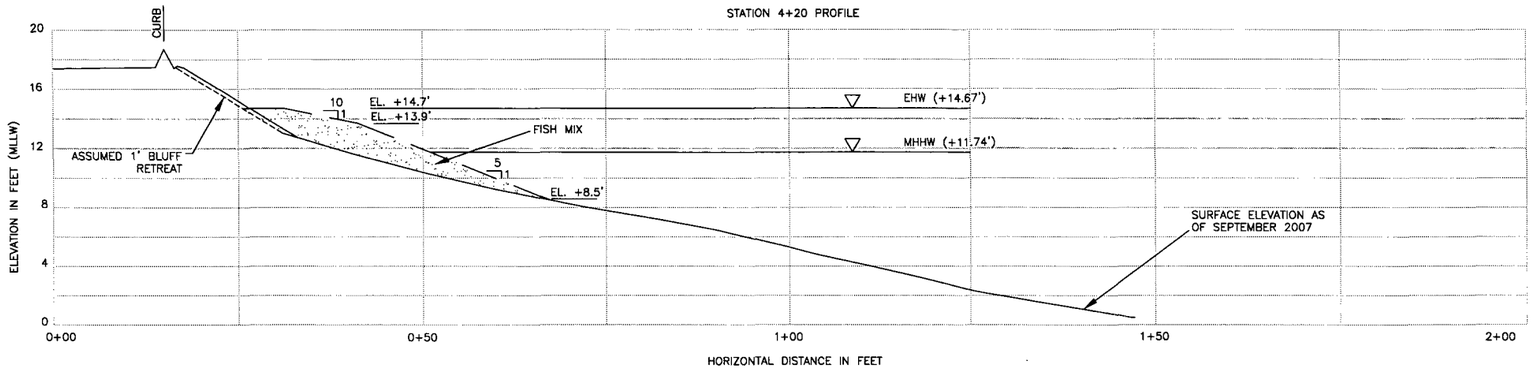
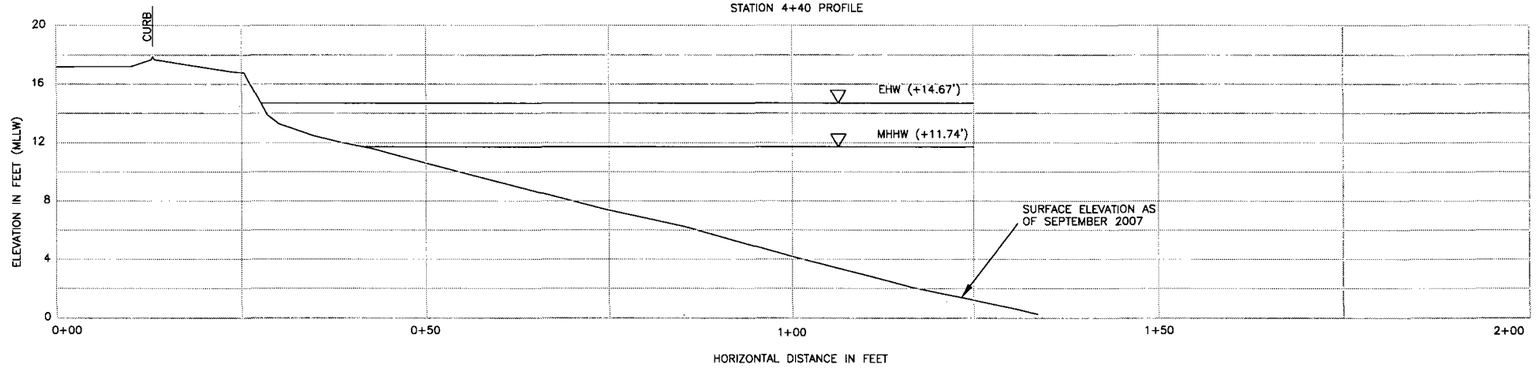


SECTION H 3



SECTION 1 3

NOTE:
1. ACTUAL VOLUMES AND ELEVATIONS MAY DIFFER THAN INDICATED ON DRAWINGS BASED ON ACTUAL FIELD CONDITIONS.

5 0 5 10 20
HORIZONTAL SCALE

2.5 0 2.5 5 10
VERTICAL SCALE

VERTICAL DATUM: MLLW = 0.0 FEET
HORIZONTAL DATUM: NAD83/91
STATION ID: 9445958, BREMERTON, WA
TIDAL EPOCH: 1983-2001

DRAFT
NOT FOR CONSTRUCTION

DRAWING REDUCED HALFSIZE

DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND NORTHWEST
SILVERDALE, WASHINGTON

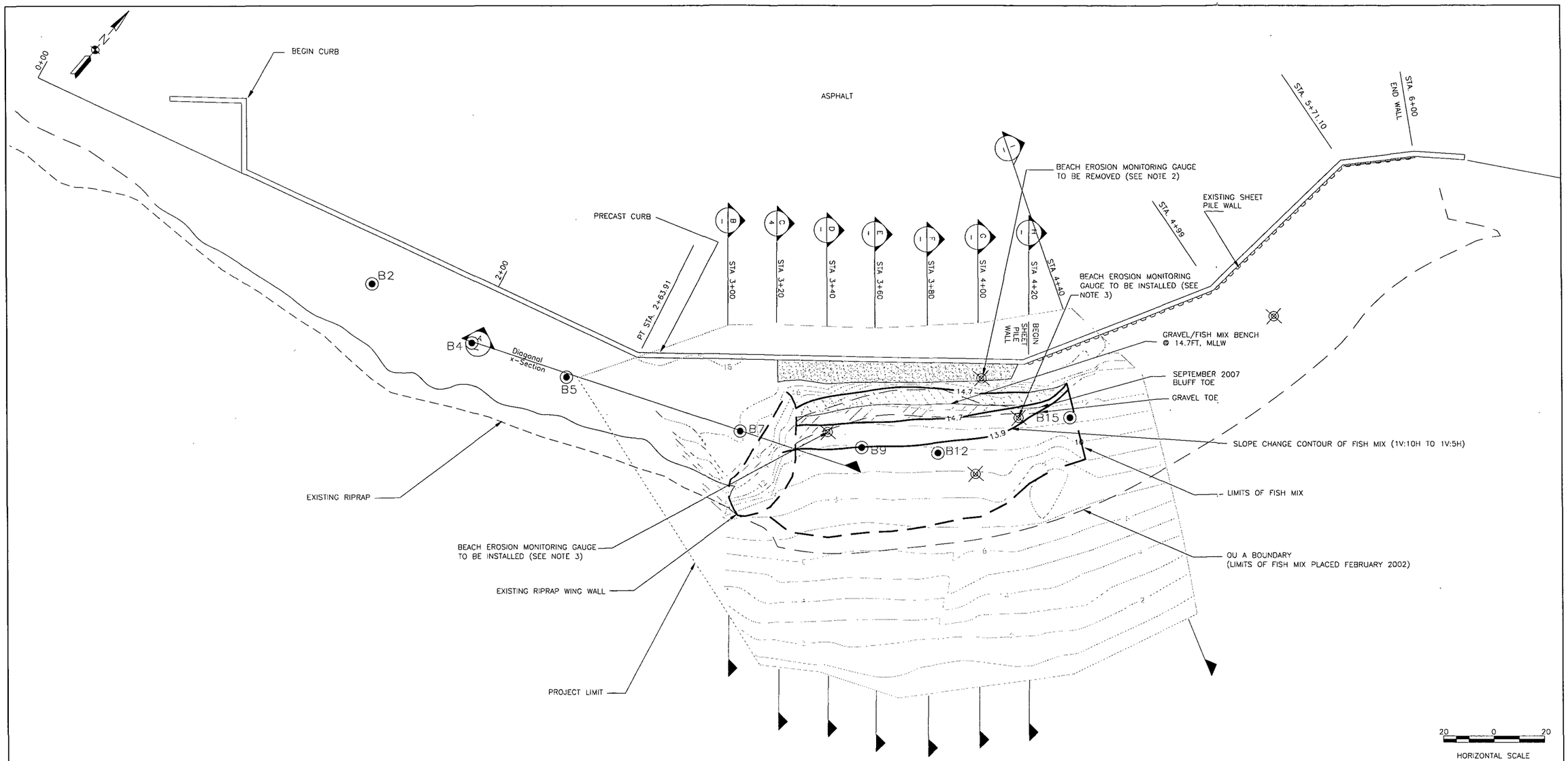
BREMERTON NAVAL COMPLEX
BREMERTON, WASHINGTON

OUA CHARLESTON BEACH ALTERNATIVE 4
FISH MIX DESIGN CROSS SECTIONS

SES-TECH

DESIGNED: ELR		APPROVED	
DRAWN: WDB		SM	
CHECKED: SO			
SIZE: D	SCALE: AS NOTED	DRAWING NO. 0031-XS-ALT4	3/3

P:\2973 CHARLESTON BEACH\CAD\APPENDIX F DRAWINGS\DESIGN MEMORANDUM JUNE 23\0031-XS-ALT4.DWG
PLOT/UPDATE: JUN 23 2008 16:21:37



P:\2973 CHARLESTON BEACH\CAD\APPENDIX F DRAWINGS\0031-GP-ALT5.DWG
PLOT/UPDATE: MAY 16 2008 08:24:46

LEGEND:

- BEACH EROSION MONITORING GAUGE
- SECTION A / A' — 0,0 — CROSS SECTION LOCATION
- CONTOUR LINES AS OF SEPTEMBER 2007
- EXISTING RIPRAP
- TOPSOIL
- B2 — EXCAVATED SOIL AND EXPOSED FILL STATION LOCATIONS

NOTES:

1. TOPOGRAPHIC SURVEY CONDUCTED BY SES-TECH ON SEPTEMBER 10, 2007.
2. BEACH EROSION MONITORING GAUGE IN TOPSOIL AND ANOTHER GAUGE ADJACENT TO THE EXISTING WING WALL (NOT SHOWN ON DRAWING) WILL BE REMOVED BY CUTTING FLUSH WITH GROUND SURFACE.
3. BEACH EROSION MONITORING GAUGE TO BE INSTALLED FABRICATED FROM 4" PVC PIPE, 6'-0" LONG. SET TOP FLUSH WITH FINISHED GRADE. CONCRETE FILLED. NEW GAUGE TO BE PLACED IN FRONT OF GRAVEL TOE.
4. PLACE APPROXIMATELY 3 FEET OF TOPSOIL OVER FILL MATERIAL. REDUCE THICKNESS AS REQUIRED TO MATCH TOP OF CURB AND TAPER TO MATCH TOP OF SLOPE.

BREMERTON TIDE DATA	
TIDE DATUM	ELEVATION (FT)
EXTREME HIGH WATER (EHW)	14.67*
MEAN HIGHER HIGH WATER (MHHW)	11.74**
MEAN LOWER LOW WATER (MLLW)	0**
*TIDAL DATA OBTAINED FROM U.S. ARMY CORPS OF ENGINEERS OFFICE AND NAUTICAL SOFTWARE.	
** NOAA STATION ID 9445958, TIDAL EPOCH: 1983-2001	

BASELINE COORDINATES AND BEARINGS	
STATION 0+00	N 206386.79 E 1188674.86
STATION 0+00 TO STATION 2+63.91	N 74°01'52"E
STATION 2+63.91 TO STATION 4+20	N 50°00'26"E

VERTICAL DATUM: MLLW = 0.0 FEET
HORIZONTAL DATUM: NAD83/91
STATION ID: 9445958, BREMERTON, WA
TIDAL EPOCH: 1983-2001

DRAFT
NOT FOR CONSTRUCTION

DRAWING REDUCED HALFSIZE

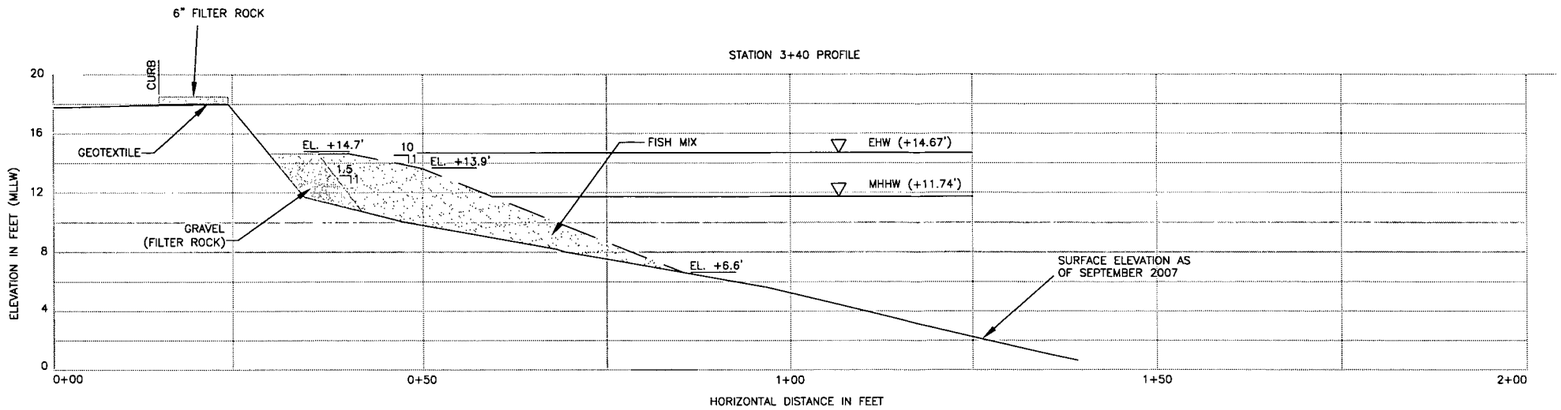
DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND NORTHWEST
SILVERDALE, WASHINGTON

BREMERTON NAVAL COMPLEX
BREMERTON, WASHINGTON

OUA CHARLESTON BEACH ALTERNATIVE 5 FISH MIX DESIGN PLAN

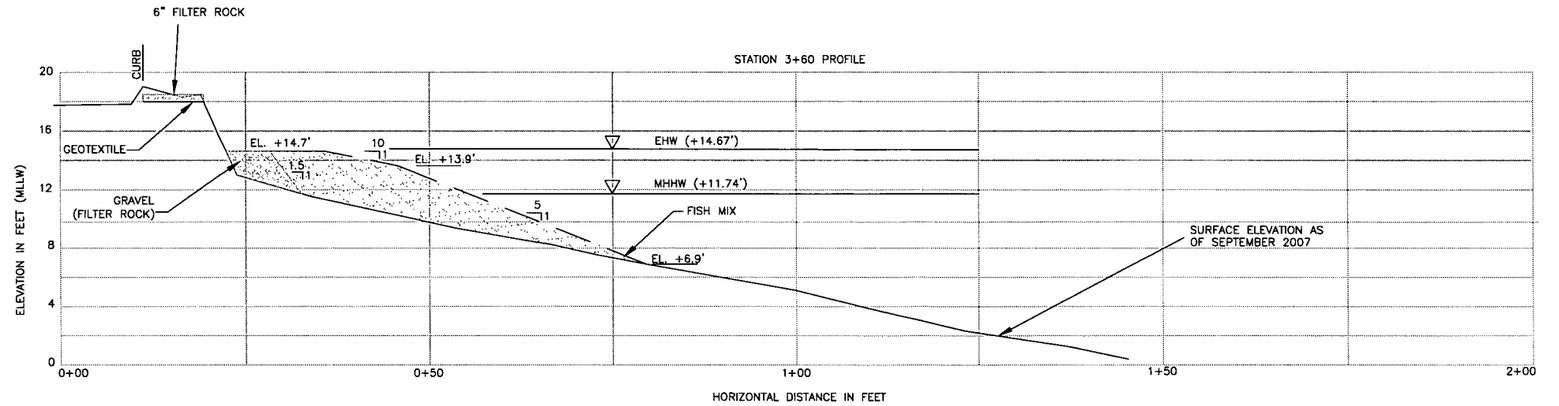
SES-TECH

DESIGNED: ELR	APPROVED		
DRAWN: WDB	SM		
CHECKED: SO			
SIZE: D	SCALE: AS NOTED	DRAWING NO. 0031-GP-ALT5	1/1



SECTION D/3

NOTE:
1. GEOTEXTILE WILL BE PLACED OVER EXPOSED TOPSOIL SURFACE AND SECURED WITH FILTER ROCK; NO VEGETATION WILL BE INSTALLED.
2. ACTUAL VOLUMES AND ELEVATIONS MAY DIFFER THAN INDICATED ON DRAWINGS BASED ON ACTUAL FIELD CONDITIONS.
3. HORIZONTAL EXTENT OF GRAVEL PLACEMENT IS LIMITED TO 18 FEET FROM TOP OF BLUFF DUE TO EXCAVATOR REACH LIMITATION.
4. EXISTING RIPRAP AND GRAVEL TOE PROTECTION WILL BE TRANSITIONED BETWEEN STATION 3+20 AND 3+30. FILL THE VOIDS OF EXISTING RIPRAP WITH FILTER ROCK BETWEEN STATION 3+15 AND 3+20.
5. GRAVEL WILL BE PLACED ALONG SHORELINE AT A 1V:1.5H SLOPE. PLACEMENT THICKNESS MAY VARY BASED ON ACTUAL FIELD CONDITIONS. NO EXCAVATION WILL BE PERFORMED PRIOR TO PLACEMENT OF GRAVEL.



SECTION E/3

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HORIZONTAL SCALE

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VERTICAL SCALE

VERTICAL DATUM: MLLW = 0.0 FEET
HORIZONTAL DATUM: NAD83/91
STATION ID: 9445958, BREMERTON, WA
TIDAL EPOCH: 1983-2001

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HALFSIZE

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BREMERTON NAVAL COMPLEX
BREMERTON, WASHINGTON

OUA CHARLESTON BEACH ALTERNATIVE 5
FISH MIX DESIGN CROSS SECTIONS

SES-TECH

DESIGNED: ELR		APPROVED	
DRAWN: WDB		SM	
CHECKED: SO			
SIZE: D	SCALE: AS NOTED	DRAWING NO. 0031-XS-ALT5	1/3

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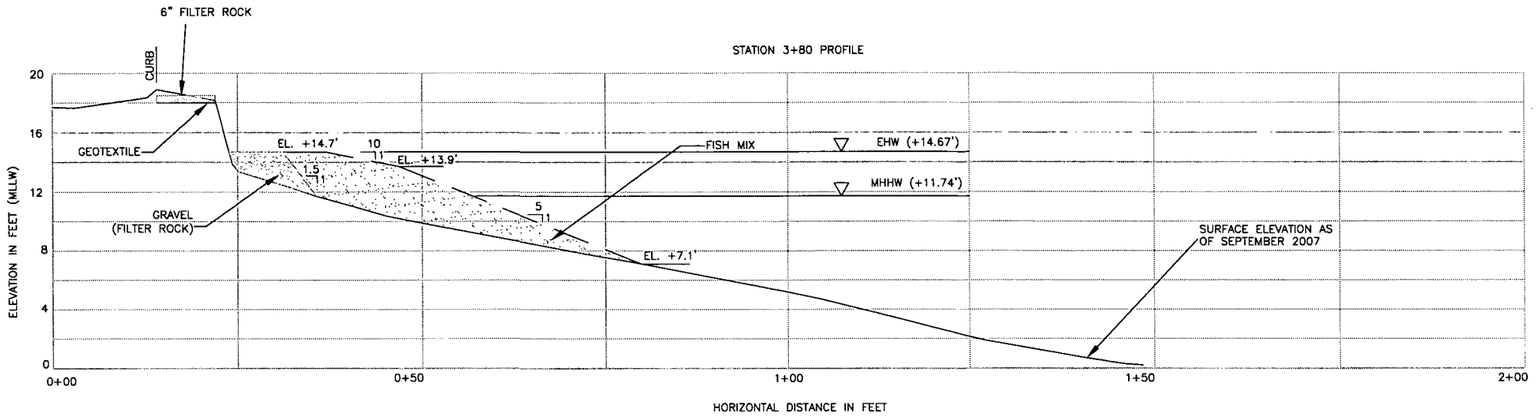
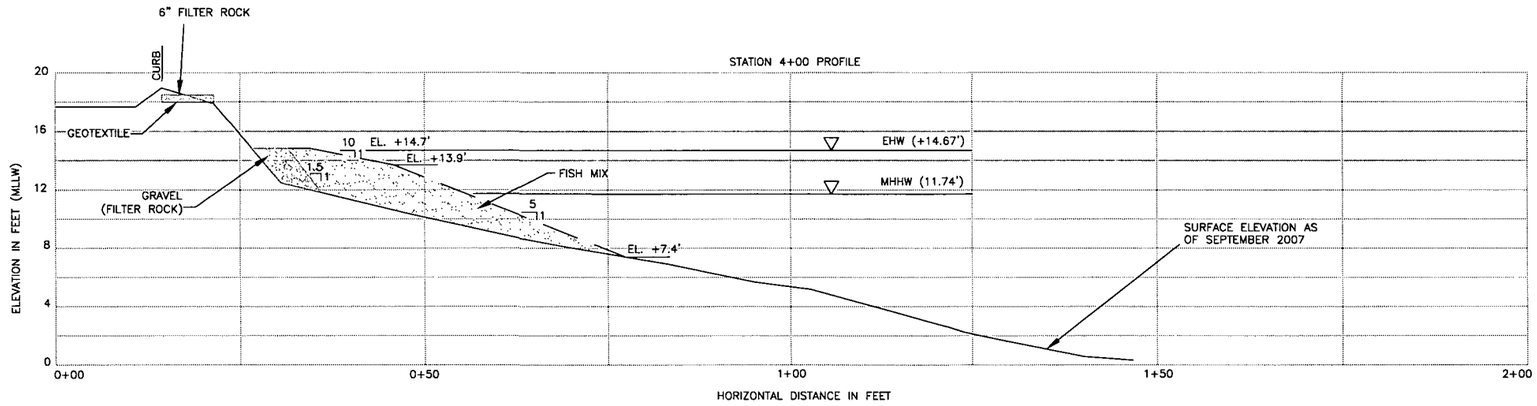
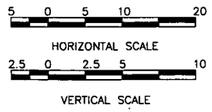


SECTION F/3



SECTION G/3

NOTE:
1. GEOTEXTILE WILL BE PLACED OVER EXPOSED TOPSOIL SURFACE AND SECURED WITH FILTER ROCK; NO VEGETATION WILL BE INSTALLED.
2. ACTUAL VOLUMES AND ELEVATIONS MAY DIFFER THAN INDICATED ON DRAWINGS BASED ON ACTUAL FIELD CONDITIONS.
3. HORIZONTAL EXTENT OF GRAVEL PLACEMENT IS LIMITED TO 18 FEET FROM TOP OF BLUFF DUE TO EXCAVATOR REACH LIMITATION.
4. GRAVEL ROCK WILL BE PLACED ALONG SHORELINE AT A 1V:1.5H SLOPE. PLACEMENT THICKNESS MAY VARY BASED ON ACTUAL FIELD CONDITIONS. NO EXCAVATION WILL BE PERFORMED PRIOR TO PLACEMENT OF GRAVEL.



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STATION ID: 9445958, BREMERTON, WA
TIDAL EPOCH: 1983-2001

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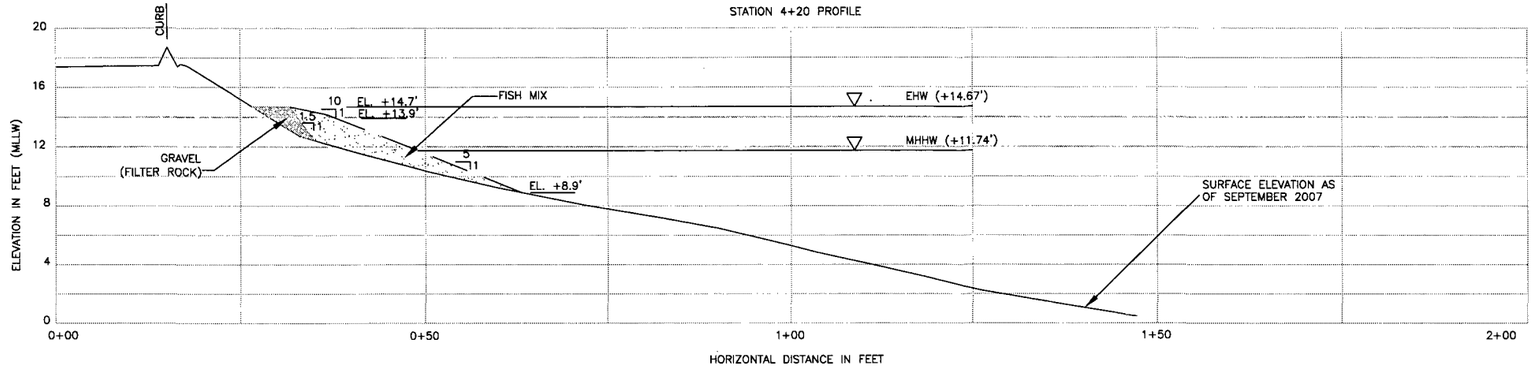
BREMERTON NAVAL COMPLEX
BREMERTON, WASHINGTON

OUA CHARLESTON BEACH ALTERNATIVE 5
FISH MIX DESIGN CROSS SECTIONS

SES-TECH

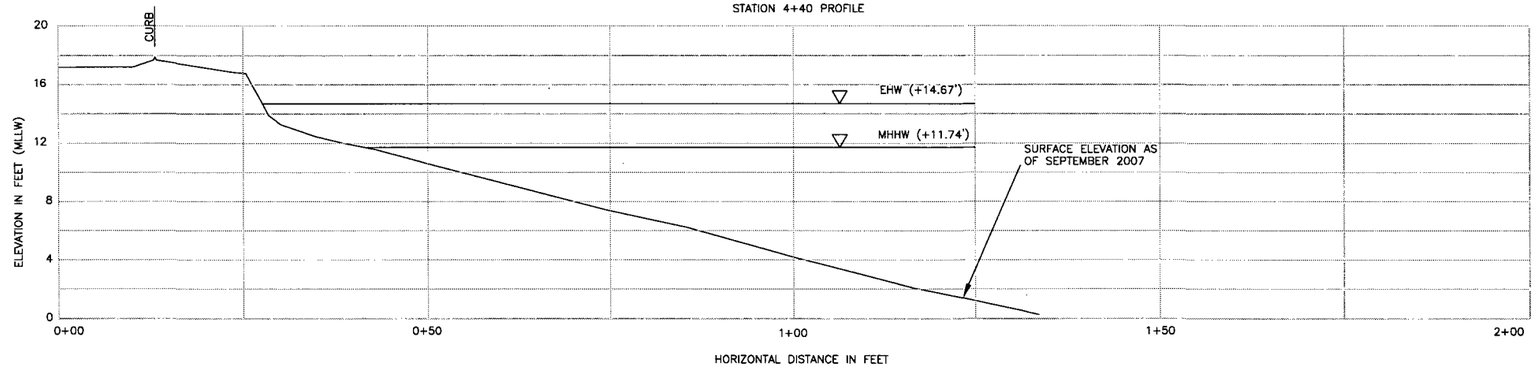
DESIGNED: ELR		APPROVED	
DRAWN: WDB		SM	
CHECKED: SO			
SIZE: D	SCALE: AS NOTED	DRAWING NO. 0031-XS-ALT5	2/3

STATION 4+20 PROFILE



SECTION H/3

STATION 4+40 PROFILE



SECTION I/3

NOTE:
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2. HORIZONTAL EXTENT OF GRAVEL PLACEMENT IS LIMITED TO 18 FEET FROM TOP OF BLUFF DUE TO EXCAVATOR REACH LIMITATION.
3. THICKNESS OF GRAVEL AND BEACH MIX WILL BE REDUCED AND TAPERED OFF BETWEEN STATION 4+20 AND 4+30.
4. GRAVEL ROCK WILL BE PLACED ALONG SHORELINE AT A 1V:1.5H SLOPE. PLACEMENT THICKNESS MAY VARY BASED ON ACTUAL FIELD CONDITIONS. NO EXCAVATION WILL BE PERFORMED PRIOR TO PLACEMENT OF GRAVEL.

5 0 5 10 20
HORIZONTAL SCALE

2.5 0 2.5 5 10
VERTICAL SCALE

VERTICAL DATUM: MLLW = 0.0 FEET
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OUA CHARLESTON BEACH ALTERNATIVE 5
FISH MIX DESIGN CROSS SECTIONS

SES-TECH

DESIGNED: ELR		APPROVED	
DRAWN: WDB		SM	
CHECKED: SO			
SIZE: D	SCALE: AS NOTED	DRAWING NO. 0031-XS-ALT5	3/3

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PLOT/UPDATE: MAY 16 2008 09:02:55

ATTACHMENT B
INTERIM REPAIR ACTION DESIGN MEMORANDUM

SES-TECH

Memorandum

To: Suzanna Jefferis, NAVFAC NW

From: Thomas Goodlin, Sealaska Environmental Services, LLC

Cc: Dwight Leisle

Date: 30 June 2008

Re: Charleston Beach Fish Mix Design Interim Repair Action Preferred Alternative Design Memo

---

1 INTRODUCTION

On 23 June 2008, a conference call was held to review the proposed repair action alternatives for Charleston Beach presented in the Revised Draft Appendix F dated 16 May 2008 and select the preferred alternative that would be implemented in August 2008. The selected alternative will be implemented as an interim repair action to stabilize the bluff and enhance the beach habitat while the Stakeholders develop a long term solution to control the erosion and protect the marine habitat at Charleston Beach in accordance with the Operable Unit A Record of Decision. Conference call participants included:

Suzanna Jefferis and Dwight Leisle – NAVFAC NW
Tyler Yasenak – Biologist, Bremerton Naval Complex
Christine Gebhardt – Environmental, Bremerton Naval Complex
Denice Taylor and Tom Ostrom – Suquamish Tribe Fisheries Department
Nancy Harney – U.S. Environmental Protection Agency
Chung Yee – Washington State Department of Ecology
Chris Waldbillig – Washington Department of Fish and Wildlife
Susan Moore – CH2M Hill
Shanti Montgomery and Tom Goodlin – Sealaska Environmental Services, LLC
Senda Ozkan – Tetra Tech EC

Listed below is the summary of the discussions held during the conference call:

- The alternatives considered for further discussion were 3, without the armor rock revetment, 4, and 5.
- The interim period was defined as approximately 3 years, to allow for an expanded study of beach dynamics prior to design of a long term remedy repair action.
- Stakeholders preferred Alternative 3, the placement of fish mix only, as the

preferred interim action. This alternative, however, was not acceptable to the Navy because of concerns that the extent and rate of erosion of the fish mix over the interim period cannot be confidently estimated. Due to budgetary constraints, the Navy has stated that after this interim action, no additional funding will be available to address renourishment of fish mix, additional erosion of fill material, or any impacts to the adjacent parking lot, prior to the long term action, if erosion occurs at an accelerated rate over the next 3 years.

- Alternative 5, placement of filter rock and fish mix was not acceptable to stakeholders because of concerns that angular filter rock may degrade surf smelt spawning habitat.

- Alternative 4, placement of armor rock, filter rock and fish mix, was revised to exclude angular filter rock. The Navy acknowledges that it is possible that placement of armor rock may result in erosion of beach and fill material in the northern portion of the site and that the long term design may require the removal of armor rock placed as an interim action.

2 PREFERRED ALTERNATIVE

Based on the 23 June 2008 conference call, Alternative 4 was selected as the proposed interim repair action design alternative. The design involves the placement of armor rock and fish mix material as indicated on the attached drawings. With this alternative, the armor rock is considered to be an extension of the existing riprap wing wall along 50 feet (ft) with its extent restricted by the amount of material presently available on site (71 cubic yards [CY]). Based on observations, the bluff erosion is most severe adjacent to the existing riprap wall between cross sections C and F, and some armoring behind the fish mix placement is important to provide protection against further bluff erosion in the interim period. The armor rock will be placed in the southwestern corner of the soft-beach shoreline to temporarily minimize the erosion from this particular area. . The armor rock will be placed in front of the existing shoreline and will be placed at a slope no steeper than 1.5 horizontal (H): 1 vertical (V) to prevent failure of armor rock. Fish mix will be placed along 120 lineal feet of shoreline and will onlap onto the armor rock. Concerns were raised by participants with the use of angular filter rock, which is unsuitable for habitat development, resulting in a decision to eliminate its use within the armor rock.

Approximate quantities of armor rock and fish mix, along with the area to be covered with these materials are listed in Table 1. These quantities were calculated assuming that approximately 1 foot of bluff has eroded since the 10 September 2007 site survey. The placement and quantity of armor rock placed will be field adjusted based on actual field conditions as indicated on the attached design drawings.

Table 1 Approximate Quantities of Proposed Design Alternative

Material	Quantity (CY)	Area (ft^2)	Notes
Armor Rock	71	652	227ft^2 of the armor rock will be covered with fish mix and 425 ft^2 of armor rock will be exposed.
Fish Mix	367	5,344	

CY – cubic yards
ft^2 – square feet

Gradation of Fish Mix

The design gradation range was determined by considering the gradation reported in the Myers Biodynamic Study (FWEC 2002) and the gradations of natural Puget Sound beaches that are known to have surf smelt spawning (Figure 1).

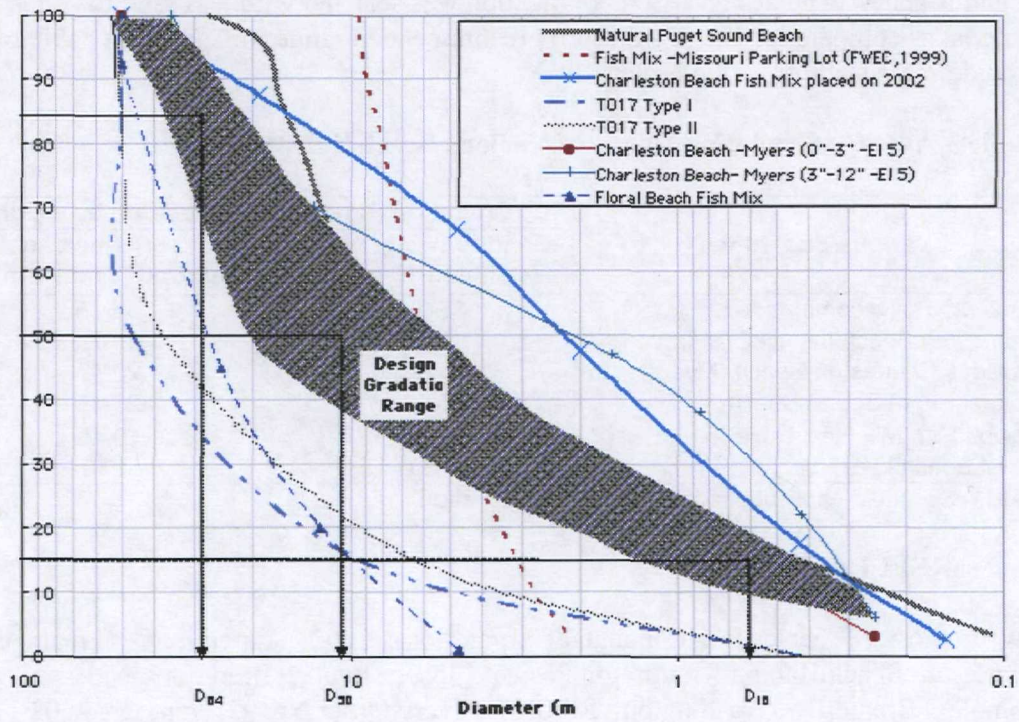


Figure 1 Fish Mix Gradation Comparison

The design gradation range for fish mix is shown in Table 2

Table 2 Gradation of Design Fish Mix

Sieve Size	Sieve Opening (mm)	Description	%Passing
2"	50	Coarse gravel and smaller	100
¾"	19	Pea gravel and smaller	50-85
#4	4.75	Coarse sand and smaller	25-45
#10	2	Medium sand and smaller	20-35
#40	0.425	Fine sand and smaller	0-15

Average gradation ranges of various beach substrates, including recommended gradation for suitable spawning substrate for surf smelt for each of the various substrates are also listed in Table 3. The design gradation of fish mix closely follows the Myers description of Charleston Beach natural substrate materials and is within the range of natural Puget Sound beaches. The design fish mix gradation was selected with less sand to pea gravel material as compared to the SAIC (2001) recommended range for spawning habitat to provide some stability to the beach.

Table 3 Average Gradation Range of Various Beach Substrates

Various Substrates	Gradation Range (% of substrate by weight)	
	Sand to pea gravel (4.75 mm-19 mm)	Typical surf smelt substrate reported (1 mm-7 mm)
SAIC (2001) Recommended	65-90	35-75
Charleston Beach Installed (2002)	65-90	35-75
Previous Charleston Beach (Myers)	35-60	20-45
Natural Puget Sound Beach	35-95	25-45
Design Fish Mix (see Table 2)	25-85	20-45
Floral Beach Fish Mix	0-25	0-10

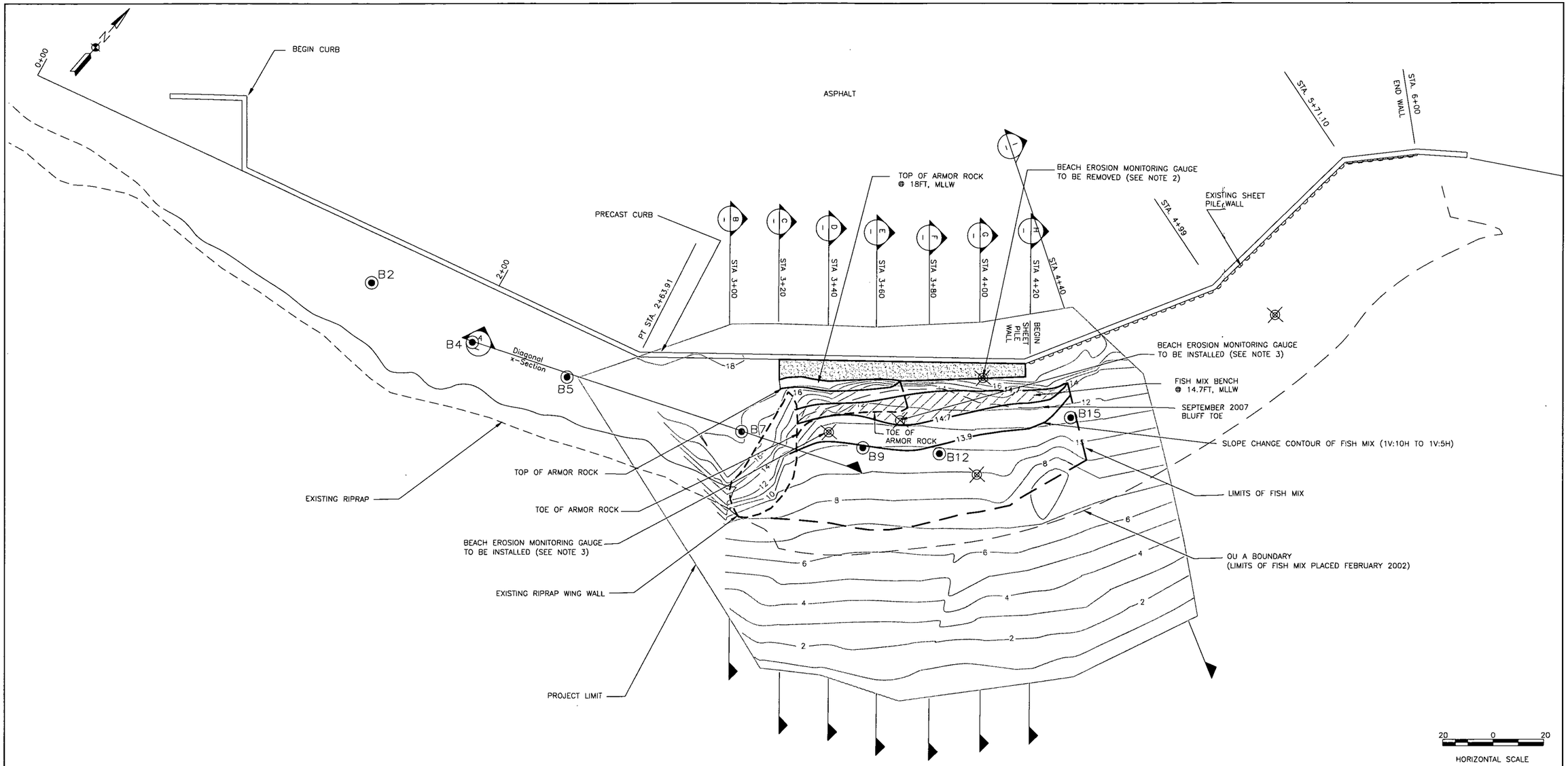
SAIC – Scientific Applications International Corporation

3 REFERENCES

FWEC (Foster Wheeler Environmental Corporation). 2002. Appendix C – Final Charleston Beach Habitat Restoration Project Closure Report, Bremerton Naval Complex, Bremerton, Washington. RACII/Delivery Order No. 92. June 28, 2002.

SAIC (Scientific Applications International Corporation). 2001. Addendum to Biological Assessment Nimitz-Class Aircraft Carriers Homeporting and Maintenance Berth Improvements. Bremerton Naval Complex, Bremerton, Washington. Northwest Facilities Engineering Command, Poulsbo, WA.

ATTACHMENT



LEGEND:

- BEACH EROSION MONITORING GAUGE
- SECTION A, 0,0 — CROSS SECTION LOCATION
- CONTOUR LINES AS OF SEPTEMBER 2007
- EXISTING RIPRAP
- TOPSOIL
- B2 — EXCAVATED SOIL AND EXPOSED FILL STATION LOCATIONS

NOTES:

1. TOPOGRAPHIC SURVEY CONDUCTED BY SES-TECH ON SEPTEMBER 10, 2007.
2. BEACH EROSION MONITORING GAUGE SHOWN IN TOPSOIL AND ANOTHER GAUGE ADJACENT TO THE EXISTING WING WALL (NOT SHOWN ON DRAWING) WILL BE REMOVED BY CUTTING FLUSH WITH GROUND SURFACE.
3. BEACH EROSION MONITORING GAUGE TO BE INSTALLED FABRICATED FROM 4" PVC PIPE, 6'-0" LONG. SET TOP FLUSH WITH FINISHED GRADE, CONCRETE FILLED. NEW GAUGE IS TO BE PLACED IN FRONT OF TOE OF ARMOR ROCK.
4. PLACE APPROXIMATELY 3 FEET OF TOPSOIL OVER FILL MATERIAL. REDUCE THICKNESS AS REQUIRED TO MATCH TOP OF CURB AND TAPER TO MATCH TOP OF SLOPE.

BREMERTON TIDE DATA	
TIDE DATUM	ELEVATION (FT)
EXTREME HIGH WATER (EHW)	14.67*
MEAN HIGHER HIGH WATER (MHHW)	11.74**
MEAN LOWER LOW WATER (MLLW)	0**
*TIDAL DATA OBTAINED FROM U.S. ARMY CORPS OF ENGINEERS OFFICE AND NAUTICAL SOFTWARE.	
** NOAA STATION ID 9445958, TIDAL EPOCH: 1983-2001	

BASELINE COORDINATES AND BEARINGS	
STATION 0+00	N 206386.79 E 1188674.86
STATION 0+00 TO STATION 2+63.91	N 74°01'52"E
STATION 2+63.91 TO STATION 4+20	N 50°00'26"E

VERTICAL DATUM: MLLW = 0.0 FEET
HORIZONTAL DATUM: NAD83/91
STATION ID: 9445958, BREMERTON, WA
TIDAL EPOCH: 1983-2001

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OUA CHARLESTON BEACH ALTERNATIVE 4 FISH MIX DESIGN PLAN

SES-TECH

DESIGNED: ELR		APPROVED	
DRAWN: WDB		SM	
CHECKED: SO			
SIZE: D	SCALE: AS NOTED	DRAWING NO. 0031-GP-ALT4	1/1

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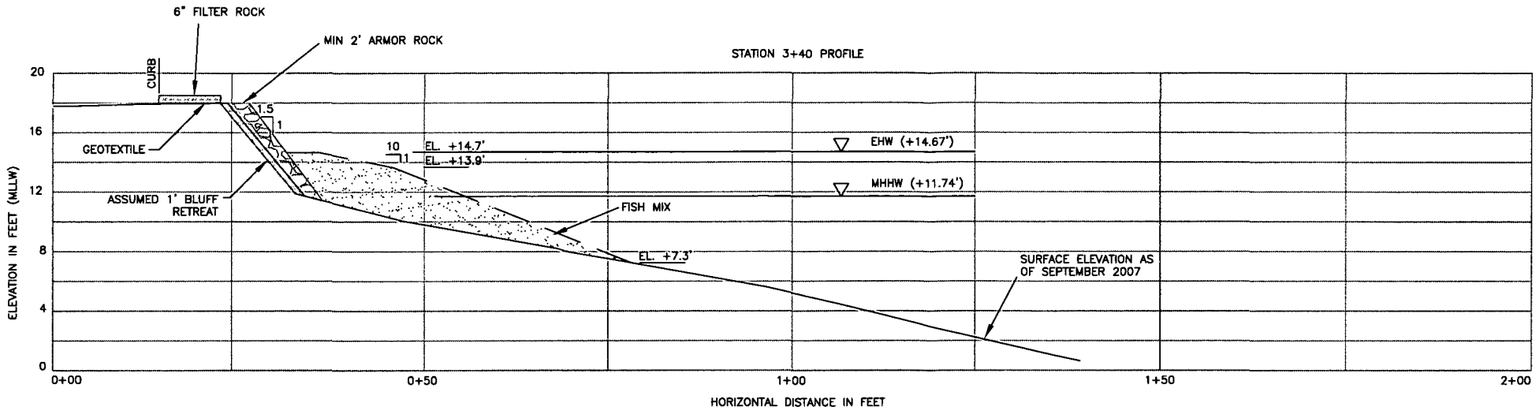
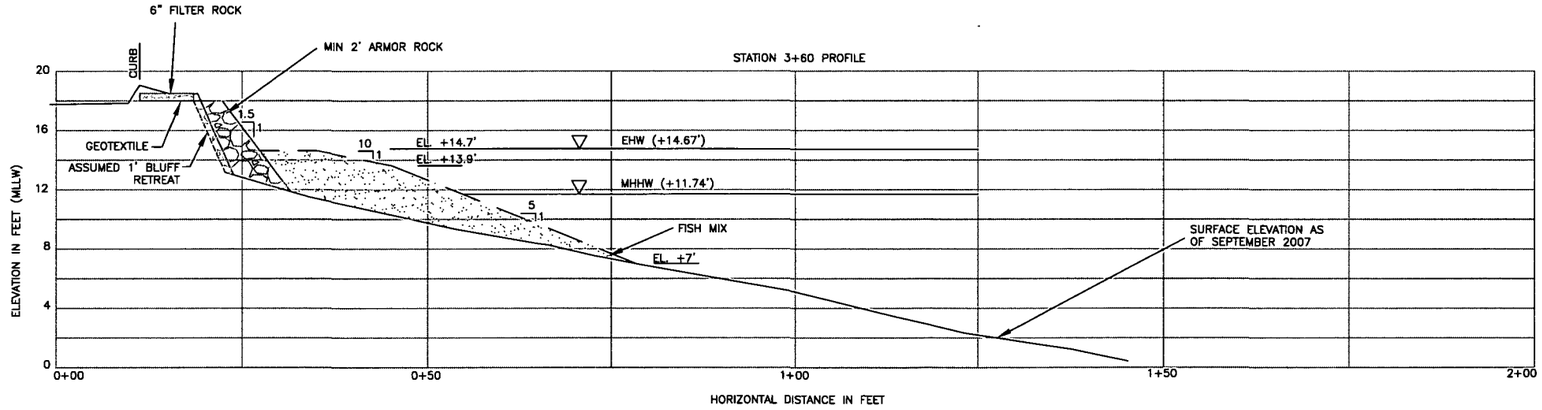


SECTION D/3



SECTION E/3

NOTE:
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2. ACTUAL VOLUMES AND ELEVATIONS MAY DIFFER THAN INDICATED ON DRAWINGS BASED ON ACTUAL FIELD CONDITIONS. PLACEMENT VOLUME OF ARMOR ROCK AND FILTER ROCK WILL BE LIMITED TO THE VOLUME EXISTING ON SITE (157 TONS OF EACH).
3. EXISTING RIPRAP AND THE NEW ARMOR ROCK WILL BE TRANSITIONED BETWEEN STATION 3+20 AND 3+30. PLACE ONE LAYER OF ARMOR ROCK BETWEEN STATION 3+15 AND 3+20.
4. ARMOR ROCK WALL THICKNESS WILL BE REDUCED GRADUALLY STARTING AT STATION 3+60 AND TAPERED OFF WITH THE EXISTING GRADE BETWEEN STATION 3+60 AND 3+70.
5. ARMOR ROCK WILL BE PLACED ALONG SHORELINE AT A 1V:1.5H SLOPE. PLACEMENT THICKNESS MAY VARY BASED ON ACTUAL FIELD CONDITIONS. NO EXCAVATION WILL BE PERFORMED PRIOR TO PLACEMENT OF ARMOR ROCK.
6. HORIZONTAL EXTENT OF ARMOR ROCK WILL BE ADJUSTED BASED ON ACTUAL EROSION CONDITIONS.

5 0 5 10 20
HORIZONTAL SCALE

2.5 0 2.5 5 10
VERTICAL SCALE

VERTICAL DATUM: MLLW = 0.0 FEET
HORIZONTAL DATUM: NAD83/91
STATION ID: 9445958, BREMERTON, WA
TIDAL EPOCH: 1983-2001

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OUA CHARLESTON BEACH ALTERNATIVE 4
FISH MIX DESIGN CROSS SECTIONS

SES-TECH

DESIGNED: ELR		APPROVED	
DRAWN: WDB		SM	
CHECKED: SO			
SIZE: D	SCALE: AS NOTED	DRAWING NO. 0031-XS-ALT4	1/3

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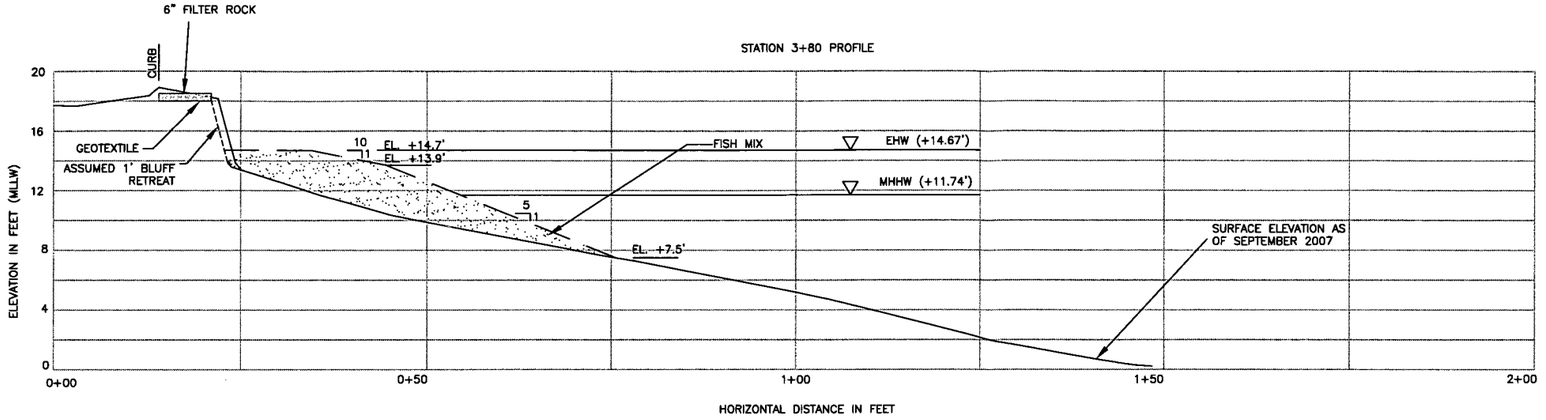

SECTION F/3

NOTE:
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4. ARMOR ROCK WALL THICKNESS WILL BE REDUCED GRADUALLY STARTING AT STATION 3+60 AND TAPERED OFF WITH THE EXISTING GRADE BETWEEN STATION 3+60 AND 3+70.
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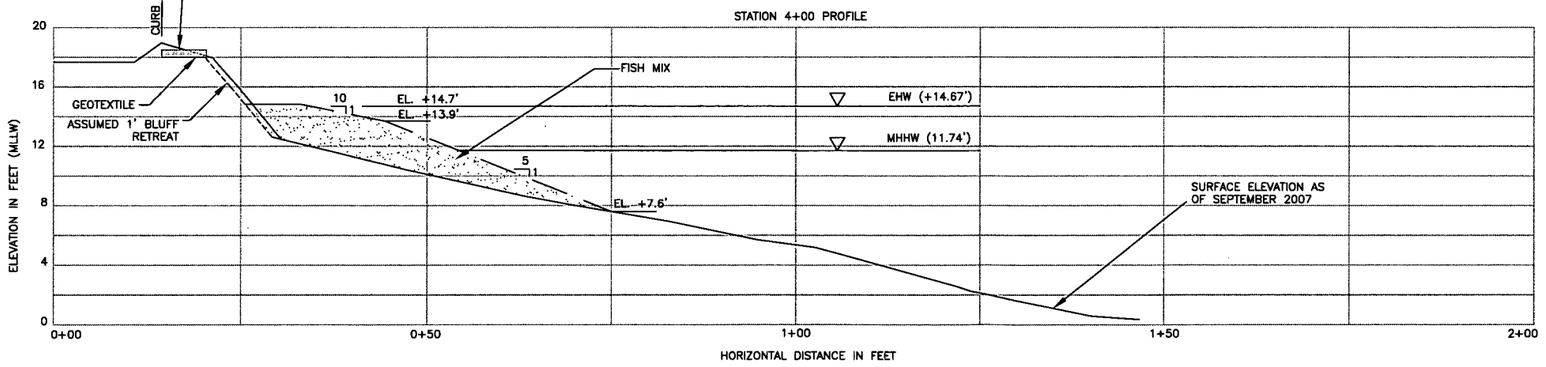

SECTION G/3

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VERTICAL SCALE

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BREMERTON NAVAL COMPLEX
BREMERTON, WASHINGTON

OUA CHARLESTON BEACH ALTERNATIVE 4
FISH MIX DESIGN CROSS SECTIONS

SES-TECH

DESIGNED: ELR		APPROVED	
DRAWN: WDB		SM	
CHECKED: SO			
SIZE: D	SCALE: AS NOTED	DRAWING NO. 0031–XS–ALT4	2/3

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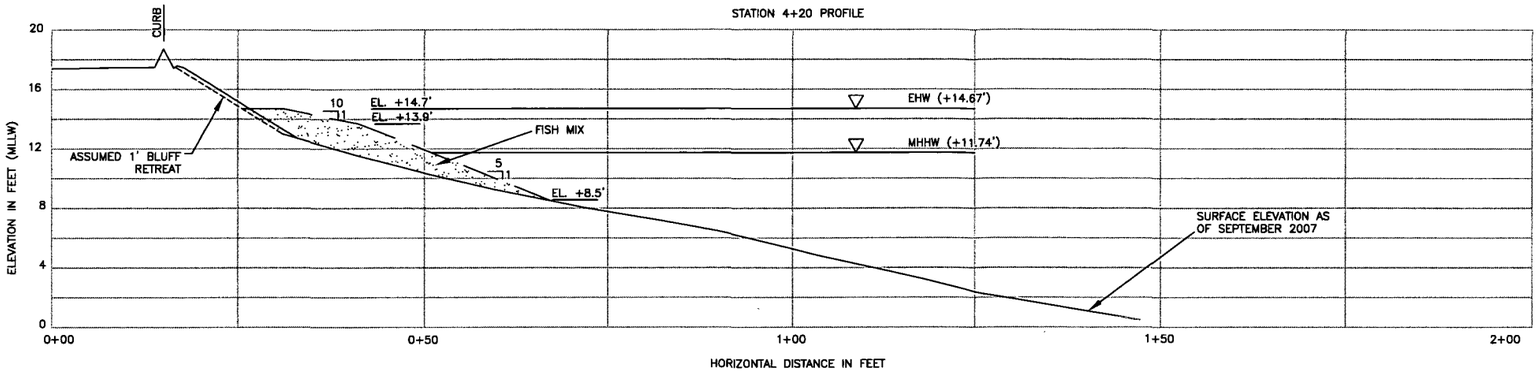

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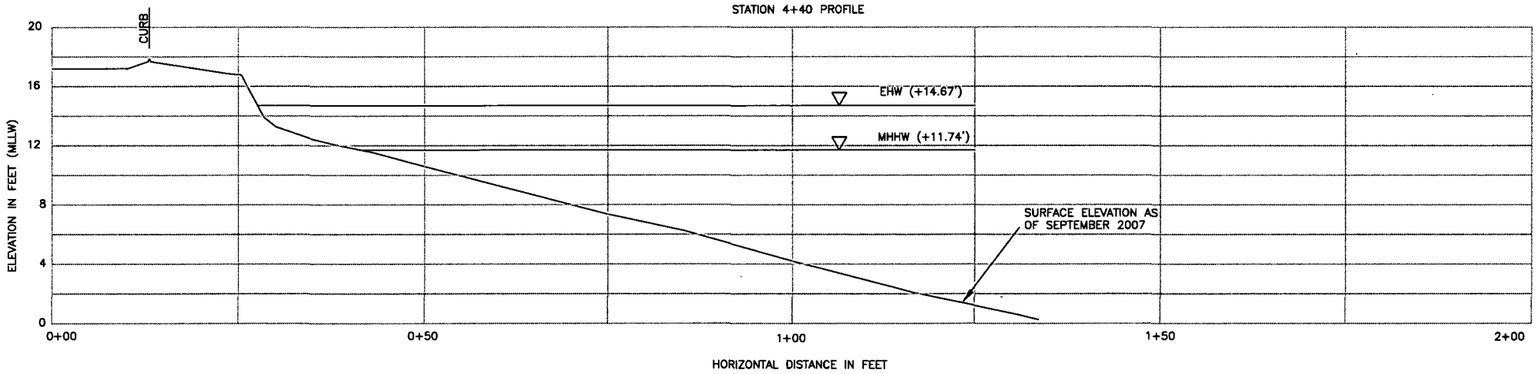

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FISH MIX DESIGN CROSS SECTIONS

SES-TECH

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